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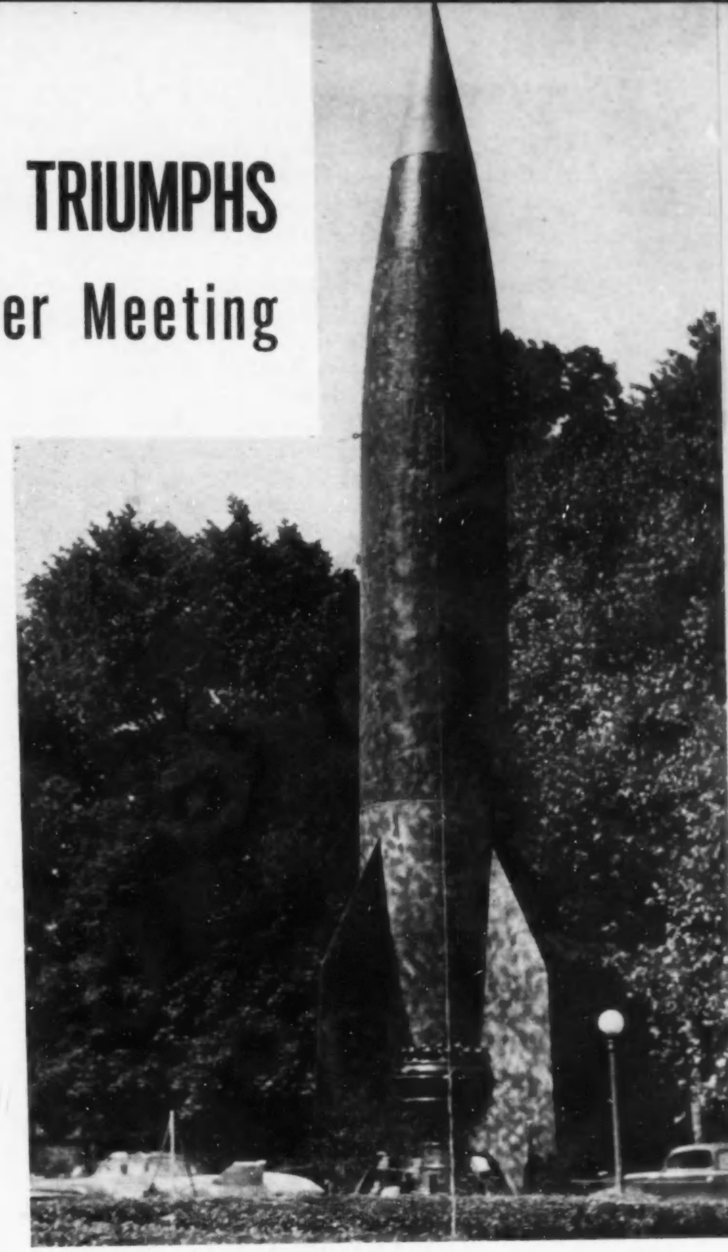


Unbounded opportunities in automotive engineering, disclosed in session after session at the first peacetime Summer Meeting since World War II, were dramatically symbolized by this 45-ft. V-2 German rocket bomb which was erected by the AAF in front of French Lick Springs Hotel

MORE than 950 SAE members and guests held the most successful Summer Meeting in the Society's history, June 2 to 7, at French Lick Springs Hotel, Indiana. The program was the heaviest technical schedule ever offered at an SAE mid-year meeting.

Engineers in every phase of the industry agreed that today's engineering developments are merely stepping stones to tomorrow's progress. "The surface has hardly been scratched" was an oft repeated phrase as designers and scientists compared notes and probed the future.

Time and again throughout the meeting sessions, in corridors, in dinner conversations, and informal groups on the verandahs and on the lawns, engineers continued discussions of new techniques and new approaches some of which are destined to be tomorrow's triumphs.

Committee meeting schedules were so heavy that some complaints were registered, particularly in respect to simultaneous gatherings where members wanted to attend both.

Free exchange of engineering ideas was cited by SAE President L. Ray Buckendale as the reason for the Society's organization more than 40 years ago. "The men we call pioneers of the industry did not see themselves as pioneers," he said during the opening session Sunday evening. Dr. Stephen Zand, who served as a French army pilot-captain in the first world war and a colonel in the AAF during the recent conflict, gave an account of his various missions with a series of colored slides of personally-made photographs.

Eleven past-presidents of the Society were introduced at the first Session by Chairman C. G. A. Rosen. The past-presidents were A. T. Colwell, A. W. Herrington, Ralph R. Teetor, Delmar G. Roos, B. B. Bachman, William B. Stout, James M. Crawford, Mac Short, Harry T. Woolson, John H. Hunt, and Col. W. H. Alden. Arriving later, Past-Presidents Arthur Nutt and H. C. Dickinson also attended the meeting.

No engineering meeting has been augmented with as extensive an exhibit of captured enemy weapons and equipment as this Summer Meeting. A total of 25 items was made available through the courtesy of the Air Service Technical Command, AAF, details of assembling and arranging the materiel having been taken care of by Col. H. E. Watson, chief, Collection Division, Intelligence T-2. The exhibit located in front of the French Lick Springs Hotel ranged from German and Japanese aircraft – including some which failed to get into production – to a series

SAE President L. Ray Buckendale (right) with George P. Dorris in his 1902 St. Louis. Behind the car are A. L. Dyke, automotive publisher, and John L. French, president of the concern which built this car designed by Mr. Dorris

of devastating radar-controlled and rocket bombs. The V-2 stood on end towering 46 ft above the lawn.

Four German and Japanese powerplants, a collection of more than 60 assemblies and parts, and 40 large captured charts and drawings of jet powerplants were shown through the courtesy of the Technical Industrial Intelligence Committee. Arrangements for this display were made by Dr. H. C. Dickinson, of the automotive advisory committee of TIIC.

Nucleus of the parade of veteran automobiles was a group of old timers loaned by Thompson Products, Inc. These included a Brush, a cross-engine Franklin, and an early Buick, among others. Earliest was a 1902 St. Louis Motor Carriage, driven from St. Louis to French Lick by its builder, Charles P. Dorris, and A. L. Dyke, automotive publisher. George K. Creson drove his 1908 Hupmobile, Lt.-Col. Donald L. Bower came with his 1924 leather covered Stutz, and E. B. Neil drove from Columbus in his 1928 Rolls-Royce.

For the first time at an SAE meeting, the Coordinating Research Council's single-cylinder test engine was shown. It had been shipped by the builder, Waukesha Motor Co.

DIESEL ENGINE SESSIONS

Chairmen

H. A. Everett ★ **F. M. Young** ★

Important revelations made in both design and metallurgy of bearings generated vigorous discussion and enthusiasm. New mathematical analysis of journal bearing load-carrying capacity completely upset conventional thinking and aluminum alloy bearing material gives promise of performance and applications not dreamed possible with standard bearing alloys. Diesel engineers were made to sit up and take notice of the excellence in design and efficient engine performance achieved by the Germans in their naval installations.

Load-Carrying Capacity of Journal Bearings – J. M. STONE and A. F. UNDERWOOD, Research Laboratories Div., General Motors Corp.

(Presented by Mr. Underwood)

TESTS inaugurated in 1930 to develop the factors other than oil film thickness responsible for the capacity of journal bearings have revealed pertinent differences between bearings carrying unidirectional and rotating loads. Resultingly, it has been possible to derive a form of Reynolds' equation which applies to a wide range of bearings when the journal is rotated at given speed and a constant load rotates in either direction at an independent speed.

The formula, Load-Carrying Capacity = K(2 Load RPM – Journal RPM), calls for definition of load-carrying capacity as the magnitude of the load required to produce a given minimum of oil film thickness, and of K as a factor involving length, diameter, clearance, minimum oil film thickness, and viscosity of oil. If the minimum film and oil viscosity be fixed, the formula shows how the magnitude of the load must vary as load and journal speeds vary.

The formula indicates that floating bushings between journal and bearing support are inefficient because load capacity is reduced. More effective use of floating bushings is made by restraining the bushing against rotation, for the rigid outer oil film then assumes high load capacity and the capacity of the inner oil film is doubled.

It is found that, with automotive engine bearings, the load-carrying capacity may be reduced at points on the cycle, but the maximum load customarily develops during a high-capacity period. Further work is necessary, for instance, to determine the load capacity of a bearing subjected to high forces for a short portion of the cycle. Thus, if a gas explosion load be imposed on a connecting-rod bearing, the oil film is subjected to squeezing action. For the short interval before the minimum oil film becomes dangerously thin, the bearing will support a load which is higher than the steady load. During the portion of the cycle when the lower average force is applied, the film thickness is re-established.

DISCUSSION

Considered extremely interesting and important by J. T. Burwell, Massachusetts Institute of Technology, was the experimental verification of a result of a classical hydrodynamic theory in the field of thick film lubrication and the long awaited mathematical analysis of dynamically loaded bearings which has been ignored to date. Mr. Burwell indicated, however, that the variations of loadings offered in the figures presented are at variance with their assumptions, pointing out their omission of the cyclical motion of the shaft in particular.

Clarified by this theory were the difficulties encountered in an experimental sleeve bearing application wherein half order shaft whirl was present, advised J. Palsulich, Wright Aeronautical Corp. Except for cases in which half order vibration occurs, there are only a few instances in radial aircraft engine bearings to which the formula applies.

One of these is the master connecting rod bearing which is a loose fit in the master rod, but restrained from rotation. Here the load rotates inside the bearing at crankshaft speed. Experience has shown that this type of bearing possesses a load-carrying capacity superior to that of a tight-fit bearing, apparently due to the high capacity oil film formed on the outer diameter – permitting good alignment of the bearing and journal.

In place of the quantity 2 x Load rpm – Journal rpm, basic expression in Mr. Underwood's formula, A. B. Miller, Pratt & Whitney Aircraft, suggested an expression that is

Part of the AAF and the TIIC-Ordnance displays of captured jet and turbine engines. The TIIC display was arranged for through the courtesy of SAE Past-President H. C. Dickinson, in his capacity as chairman of the Advisory Committee of the TIIC Automotive Team.

exactly equivalent, except for effects of centrifugal force, and which would seem to give a simpler physical picture of the situation. Mr. Miller suggests that the investigator orient himself in fixed relationship to the load and to express load-carrying capacity as a function of the absolute value of journal rpm + bearing rpm, where speed is taken relative to the load and the algebraic sign is the same for rotation in the same direction.

That this entire concept is timely and necessary was proven by Prof. M. C. Shaw, Massachusetts Institute of Technology. He illustrated his point with the case of an undirectionally loaded bearing in which the journal and bearing elements rotate in opposite directions at the same speed. Relative speed of the two bearing surfaces is twice what it would be for a conventional bearing in which the shaft rotates at the speed of the journal while the bearing surface is stationary.

Aluminum Alloys for Bearings – H. Y. HUNSICKER and L. W. KEMPF, Aluminum Co. of America.

(Presented by Mr. Hunsicker)

INTENSIVE research to develop materials satisfactory for connecting-rod and crankshaft bearings of internal combustion engines has produced several aluminum alloys which promise to be suitable both for high-duty engine service and commercial applications. Bearings machined from permanent mold castings of an alloy composed of 6.5% tin, 1% nickel, 1% copper, and the rest commercial-purity aluminum, are said to have revealed consistently superior fatigue resistance, unusual ability to function under conditions leading to substantial shaft deflections, and resistance to corrosion by acid-containing oils as well as to abrasion by foreign hard particles.

Aluminum-alloy bearings composed of 6.5% tin, 2.5% silicon, 1% copper, 0.5% nickel, and the balance commercial-purity aluminum, are said to have demonstrated the same superior load-capacity and wear characteristics, plus a distinct improvement in frictional and anti-scoring qualities. In high-speed tests for load capacities, with the coefficient of friction and volumetric wear taken as functions of the applied load, it was observed that copper-lead bearings developed extreme temperatures at loads above 200 lb, and babbitt bearings wiped badly at 400 lb. The aluminum-alloy bearings operated satisfactorily at 617 lb, with unit bearing pressure reaching 3800 psi at the end of the 10-minute run.

Experiments with methods of fabrication indicate the possibility of convenient and economical production by permanent mold processes. Bearing inserts for small engines and bushings may be die-cast with wall thicknesses in the range of 0.060 to 0.100 in. Extruded shapes are produced by careful workmanship. Production of rolled aluminum-alloy sheets to close dimensional tolerances in gages suitable for thin wall bearings suggests the feasibility of a highly economical fabricating procedure consisting of blanking, forming, and a minimum of machining. Machining qualities invite high-speed cutting and finishing operations.

DISCUSSION

High-silicon, low-nickel aluminum-alloy bearings now are in production and use, according to G. B. Grim, Caterpillar Tractor Co. Operations show that foreign hard particles become imbedded in the material, preventing damage to the bearing. Even bearings which have seized to the journal are not permanently damaged; adhering material readily is removed.

Substitution of aluminum-alloy for other bearings, however, is not the solution for all bearing problems, because other changes must be made to obtain maximum conditions. Still, aluminum-alloy bearings appear to solve many troublesome problems, such as operating experimental engines for periods sufficient to obtain necessary data.

Steel-backed aluminum-alloy bearings are undergoing tests. While their principal weakness appears to be occasional failure of the bond between bearing material and back, such failures are considerably fewer and less extensive than with steel- or bronze-backed babbitt despite operation at higher temperatures and more than double the load.

Initial experience with aluminum-alloy Al-Sn-Cu-Ni bearings involved installation in a two-cycle, heavy-duty diesel research engine which was destroying babbitt connecting-rod bearings within 200 hr, E. L. Dahlund, Fairbanks, Morse & Co., explained. After installation of aluminum-alloy bearings, the maximum firing pressure was increased 200 psi, maximum bearing load 20%. The first set of six bearings showed no signs of wear after 1100 hr and were run 900 hr additional. A second set operated without incident for 2900 hr. Other test runs disclosed no noticeable deterioration of bearings or shaft after more than 9000 hr under maximum unit loading of 2040 psi.

Simplicity of the aluminum-alloy bearing in solid form is believed to have manufacturing and cost advantages.

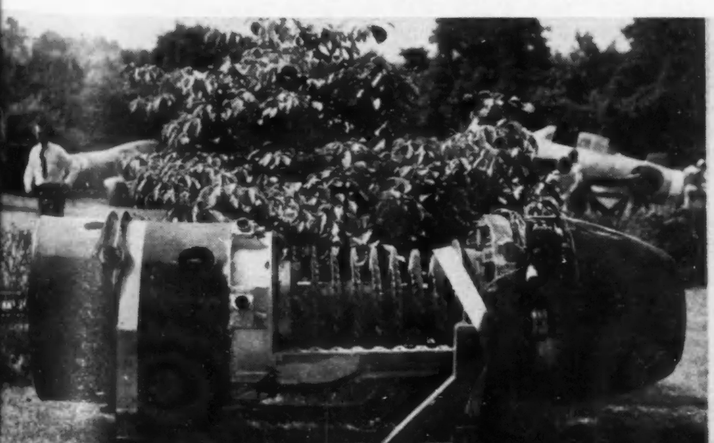
Conformability and embeddability factors were not considered too serious by G. E. Burks, Caterpillar Tractor Co. Good structural design of bearing supports and crankshaft with a greater degree of manufacturing perfection, he felt, obviates the need for conformability. Likewise, cleanliness of the bearing lubricant reduces the embeddability factor.

Feared by Mr. Burks was that aluminum alloy bearings would be considered a cure-all and be manufactured by organizations with little or no knowledge of the proper fabricating technique. If aluminum bearings are to do the job expected of them, he maintained, special care and precision methods should be observed in their manufacture.

Survey of German Diesel Engine Development, by C. G. A. ROSEN, Caterpillar Tractor Co.

GERMAN diesel practice suggests a number of trends worthy of study and reveals design refinements which could be used to improve performance and correct operating difficulties. Although

Two items in the elaborate aircraft and bomb display supplied through the courtesy of Technical Intelligence (T-2) Army Air Forces. A total of 25 items was displayed



Past-presidents A. W. Herrington, Ralph R. Teetor, B. B. Bachman, and James M. Crawford, with Toastmaster C. G. A. Rosen, extreme right, at the speakers' table June 2. Thirteen past-presidents attended the 1946 Summer Meeting. Picture at right shows Dr. Stephen Zand, who spoke Sunday evening, and Past-Presidents H. W. Alden and J. H. Hunt

no one German practice immediately is applicable to American diesels, benefit possibly will come from critical comparisons and by drawing upon German experience to solve problems created by crucial operating situations.

Excellent design and careful planning are evident in a German 16-cyl horizontally-opposed engine undergoing development for compression ignition and benzine spark ignition. The engine, found at the Kloekner-Humboldt Deutz A. G. Werke at Oberursel, produces 1800 hp at 2500 rpm. Its weight, 3000 lb, suggests possibilities for use in PT boats and high-speed amphibious vessels as well as for the design purpose, powering aircraft and tanks. This engine employs improved loop type port scavenging following principles established by P. A. Kind, of Thurin, in 1908. Higher power outputs are sought through the use of an exhaust turbo blower as a primary stage with the compressor discharging into a centrifugal engine-driven blower as a second stage.

The Machinen Fabrik Augsburg-Nurnberg A. G. at Augsburg produces an outstanding double-acting two-cycle engine. In a loop type port scavenging system, a maximum of 77 lb/sq in bmep is averaged for the top and bottom cylinders in a design weighing 13.2 lb per hp. The continuous load rating is regarded as high for engines of this size and power, reaching 83% of maximum, or 500 hp per cylinder.

German efforts to increase engine output per cubic inch of piston displacement are directed toward two-cycle, small bore, high speed engines with uniflow scavenging. Reluctance to use poppet valves in cylinder heads has pointed design toward loop type port scavenging, with reliance placed upon higher charging pressures and more efficient exhaust gas turbo blower applications in a two-stage system to produce higher bmep. Higher speeds appear to have been made economically usable by reducing friction losses. This advantage is gained by means of roller bearings, rigid crankcase and main bearing structures to assure accuracy of crankshaft alignment. Tendency has been to increase both speed and bmep in reducing the cubical dimensions of powerplants, with indications that problems increase in direct ratio to bmep almost as the square of the speed. Maintenance records, however, justify this trend in developments for naval uses.

Great faith appears to be placed in the value of laboratory fatigue and dynamic and static stress studies on crankshafts. Daimler-Benz regularly resorts to such tests to improve performance. Machinen Fabrik Augsburg-Nurnberg, oldest diesel-manufacturing company, cooperated with Oberkommando der Kriegsmarine in building a 4,000,000-mark laboratory for crankshaft testing. Evidently Daimler-Benz and MAN agreed there should be no "skip speeds" in the operating range of marine installations. Of particular interest are resonant fatigue testing machines in torsion, and a multi-throw crankshaft fatigue machine, unique in that it carries a constant steady torque during the tests and also provides a superimposed vibration torque.

DISCUSSION

German diesel developments have paralleled American, leading in some details, lagging in others, and, quite generally, reaching the same engineering conclusions by different routes, Com. W. W. Brown, Navy Bureau of Ships, reported. Study of German progress, however, has revealed that certain specific developments are worthy of further consideration. These include:

- Continued efforts to increase bhp per cu in. through supercharging.
- Increasing tendency to develop and to use superchargers.
- Refinement of design in all details of construction.
- Emphasis upon extremely stiff structures to hold bearings in position and to minimize crankshaft distortion.
- Avoidance of designing and using engines requiring additive lubricating oils.

Diesel development both in Germany and in the United States and for naval as well as industrial service is mutually beneficial to the Navy, to industry, and to consumers. Future developmental trends similarly can be parallel, with marked emphasis placed upon obtaining higher supercharging pressures through use of exhaust gas turbo blowers; producing greater horsepower from lighter engines occupying less space; improvement of combustion for partial load operation; increasing the use of light-weight alloys; developing cleaner and better fuels; and meeting competition from gas turbines and hot air engines.

German diesel engine probably most productive in terms of horsepower was the MAN 40/46 used for submarine main propulsion, according to Gordon Murphy, Fairbanks, Morse & Co. It was a four-cyl supercharged powerplant weighing approximately 44,000 lb, with a supercharged rating of 2,000 hp. Salt water cooling was employed to save weight, which further was reduced by hand-lubrication of important parts. However, construction called for 21,000 man-hours of shop and foundry labor, largely because of the welded construction and excessive machining required to bring the weight down to 22 lb per hp.

German operating records reveal that repetitive troubles led to removal from the otherwise highly satisfactory MAN of exhaust-driven turbochargers, which apparently produced high and unbalanced exhaust temperatures, and "Pielstick" dampers, which were effective in limiting the amplitude of torsional vibrations, but became annoying because of spring breakages. Connecting rod bearing failures also were frequent, usually being traced to fatigue of the high-lead babbitt lining.

German designers gave little consideration to the manu-

facturing cost in dollars per hp, a basic consideration in the United States.

American engineers will be able to inspect and to use German testing equipment which the U. S. Navy is evacuating from Augsberg to Annapolis, Tore Franzen, Chrysler Corp., reported. Some of it will be helpful, although it is apparent that the Germans are about 10 years behind in some techniques, including those of strain testing and oscillographic studies.

The Germans put diesel engines to various uses, frequently in preparation for military service. A 120 cu in. diesel engine operated for years in a taxicab at Stuttgart. In another city a German 12-cyl diesel was used interchangeably by a motor bus and a locomotive, Austin M. Wolf, consulting engineer, told the audience.

American engineers should not pass off as ridiculous the German MAN and Daimler-Benz diesel engines available for study in this country, Arthur W. Pope, Jr., Waukesha Engine Co., said. They have many features worthy of careful consideration.

Some German submarine developments are neither new nor original, according to J. Barraja-Frauenfelder, American Locomotive Co. The underwater exhausting system, for instance, was developed by the American engineer, Lake, about 1900, but was not installed by the U. S. Navy, which then could visualize no practical use for it.

AIR TRANSPORT SESSION

L. C. Sorrell, Chairman

The economic aspects of airline operation were studied from several angles at the air transport session, which consisted of a symposium on potential and realized economies in air transportation.

Simplifying Terminal Problems – S. J. SOLOMON, Atlantic Airlines, Inc.

"SIMPLIFYING terminal problems," Mr. Solomon asserted, "is the greatest problem facing air transport industry today."

The air transport industry, he continued, must learn to think in terms of the great mass of our people being potential travelers, rather than limiting itself to thinking of penetrating only the Pullman market. It will thus be necessary, he said, to do everything reasonable to reduce costs and simplify handling problems.

Specific suggestions made by Mr. Solomon included:

1. There should be an all-inclusive fare covering ground transportation to and from airports in addition to the air fare.
2. Reservations systems must be simplified.
3. Full and frank disclosure should be made when the departure or arrival of an airplane will be delayed.
4. Ticketing of passengers should be simplified, and only one checking in of passengers should be necessary.
5. Planes should have self-contained steps.
6. Planes should be designed with several full-size entrances and exits.
7. Planes should be equipped with reversible pitch propellers that will enable them to run right into a dock where the passengers will have means of ready ingress and egress.

The author pointed out that the accomplishment of many of these things, however, depends on the complete cooperative efforts of the airlines. The age of individual effort of the airlines to outdo one another in the number of personnel they have on the ramp and the assortment of equipment of various makes and designs must end, he said, in the interest of mass transportation and its rapid and easy handling, thus contributing to the simplification of terminal problems.

Cost Aspects of Airline Policies and Procedures – R. D. SPEAS, American Airlines, Inc.

TECHNICAL personnel undertaking planning and operation of airline aircraft must become cost conscious, the author said, in his discussion of how to maintain maximum overall efficiency in airline management.

Under normal conditions, airplane utilization must be determined by the amount of flying that can be accomplished on acceptable schedules to the public with sufficient reserve coverage and maintenance time.

Reserve coverage is provided by scheduling less flying time than is possible and thereby providing a reserve against maintenance difficulties or operational conditions. In general, the quantity of reserve coverage has been determined by experience and judgment, and represents a fertile field for future analytical study.

Using "maximum payload miles per dollar" as the basis, Mr. Speas analyzed the cost aspects of airline policies. In order to attain the most economical cruise control procedures, he pointed out that payload carried and direct flying cost per mile (both of which vary according to cruising altitude and power) must be studied.

Another important factor that must be analyzed is the value of weight savings, which varies according to the type of airline operation involved, so that the value of a pound saved may be as little as a few cents or as much as $2,000 for one airplane during a year of airline service.

In order to evaluate properly the economic effect of weight changes, the airline must periodically examine its operations and analytically determine the current value in "dollars per pound." One method of determining this value was explained by the author.

A study of the basic weight evaluation formula indicates, he said, that with all traffic considerations equal, the only variation in types of aircraft is in speed. Twenty-five per cent difference in speed represents directly a difference of 25% in weight value, he reported, while variation in aircraft size does not affect weight evaluation.

Economic Factors in Air Transportation Which Will Control Profits in 1946 and 1947 – HAL E. NOURSE, United Air Lines, Inc.

THE profits that airlines made during the war period will be greatly reduced during 1946 and part of 1947, according to Mr. Nourse, despite the larger and more efficient flying equipment that is expected to become available in this period.

Technical sessions stimulated vigorous discussions throughout the week. This meeting had a heavier technical schedule than any SAE Summer Meeting to date

A few of the 950 who attended (above), Col. H. E. Watson (right), chief of Collection Division, Technical Intelligence (T-2) AAF Air Materiel Command, who supervised the display of captured enemy aeronautic equipment

This anomalous condition was explained by Mr. Nourse to be due to many factors, such as:

1. A return toward normal travel conditions, with a lessening demand for air travel per airplane in service.

2. Replacement of fully depreciated airplanes, which will increase airplane depreciation charges per volume carried.

3. Catching up on construction and ground facilities held static during the war, which will increase ground depreciation charges per volume carried.

4. A sharp drop-off in war mail tonnage, which, together with lower ton-mile revenue rates compared with the wartime average, will adversely affect postwar profits for at least two years because the miles flown will not be reduced as a result of reduced mail volume.

5. The cost of doing business (labor, services, materials, and so on) will continue to increase for some time to come.

6. During 1945 domestic airlines reduced fares in the face of a general rise in price levels. The real cost of passenger air transportation today, in terms of the 1940 price level, is 3-3½¢ per mile. Although this reduction in air fares will create additional volume, some air transport economists are doubtful that the increase in volume at lower fares will result in additional profits during 1946-1947.

7. Loss of prorate of burden of costs to military service contracts.

DISCUSSION

Terminal problems are growing in importance every day for all forms of transportation, according to Dr. L. C. Sorrell, University of Chicago and Air Transport Association, who said that in this connection an accurate definition of the phrase "terminal costs" is needed. Cost of mobile equipment has been increasing for all forms of transportation, including the airlines. This increase he attributed to the improvement in service that the passenger is getting – and at lower cost.

Cost reductions can be cut suddenly due to the discovery of some new process or material that is much cheaper than the old one, or there can be a gradual whittling away of the cost of a large number of items. He felt that some of the policies discussed by Mr. Speas should help to reduce airline costs over a period of a good many years, despite the steady rise in prices.

A rise in the tariff rates of passenger planes was predicted by Mr. Nourse, although he thought that the rise might be disguised by giving the passengers better service.

R. N. Du Bois, Brazilian Aeronautical Commission, couldn't believe that an airline operating planes for 12 hr per day gains merely in lowered depreciation costs over the line that operates its planes only 6 hr a day. He also questioned the use of an airline operating one plane as a good illustration from which to draw conclusions. An engineer doesn't draw a curve through only one experimental point that in itself is doubtful.

Other factors than depreciation are involved, Mr. Speas replied, but their effect is quite small. For instance, there is no gain in hangar space because airlines don't keep their planes in a hangar unless they are being repaired.

Operating costs, he explained in answer to another question, are based on the classical Mentzer-Nourse cost formulas, with the indirect costs being estimated. The analysis was purely a forecast and was not based on actual operating experience, he said.

AIRCRAFT POWERPLANT SESSIONS

Chairmen

Robert Insley — **R. M. Hazen**
A. T. Gregory — **Arthur Nutt**

Some of the extensive development work that is being done on jet engines was revealed at the powerplant sessions, which also featured moving pictures of engine combustion taken as fast as 200,000 photographs per sec. In addition, starters, fuels for light aircraft engines, and combat performance of engines came in for their share of attention.

Aircraft-Engine Starters – ARTHUR BEIER, Jack & Heintz, Inc.

ELECTRIC starters to be used on military craft have been reduced in weight by about one-half, their reliability has been increased, and simplification of installation, operation, and maintenance has been accomplished, Mr. Beier reported in a review of starter design and selection problems both for conventional engines and for turbo jet and gas turbine engines.

The following requirements must be fulfilled, Mr. Beier stated, before successful starting can be attained:

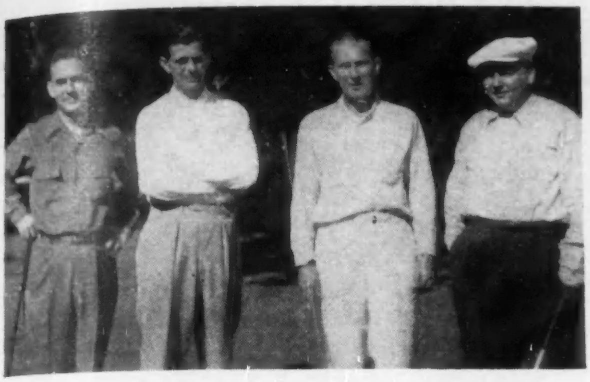
1. The engine must be turned over with the starter.

2. A combustible mixture of vaporized fuel and air must be available in the cylinders.

3. An adequate spark must be produced.

4. The engine must develop sufficient power to overcome its own friction and accelerate itself to its desired operating speed.

5. The lubricant must have suitable flowability and viscosity to



Fine weather throughout the week made golf popular. Among the foursomes were W. B. Bassett, M. D. Archangeli, V. C. Young, and R. L. Weider

Men's golf champion was Frank E. Farrell (left). At the right are E. L. Carroll, SAE staff, and the hotel's pro, Mel Smith

permit an adequate supply to reach the engine.

These requirements must be met both for reciprocating engines and for gas turbine and turbo jet engines to accomplish starting successfully; however, the author reported, the characteristics of the turbo jet engines and the operational problems of their use result in considerably different types of equipment than those used on present-day reciprocating engines.

For instance, the starter power requirements of turbo jet and gas turbine engines are considerably in excess of those necessary for reciprocating engines of similar output, so that extensive development work is necessary along these lines; for the moment, however, he said that electrical starters will be used because they are the simplest and most reliable units now available.

Fuel-Air Ratio Required for Constant-Pressure Combustion of Hydrocarbon Fuels – NEWMAN A. HALL, United Aircraft Corp.

FORMULAS and charts to be used in the determination of the fuel-air ratio required for constant-pressure combustion of hydrocarbon fuels under ideal conditions were presented by Mr. Hall, who reported that these data should be particularly useful in gas turbine and jet propulsion combustion analysis.

As most constant-pressure combustion will occur with lean mixtures, according to the author, he restricted his analysis to this condition. It does cover, however, a wide range of fuel hydrogen-carbon ratios and heats of combustion.

The charts give a rapid determination of the fuel-air ratios and include correction factors that take into consideration the variation in hydrogen-carbon ratio and the heat of combustion. Correction factors are also given that take care of the effects of both the products of previous combustion and the water vapor in the inlet air.

The author also introduced the concept of net products of combustion, representing the difference between the water vapor and carbon dioxide added by combustion and the oxygen subtracted; he showed that this is a convenient tool to use in discussing the thermodynamic characteristics of the gases discharged from the combustion process.

Light Aircraft Service Experience with All-Purpose Fuel – ROBERT V. KERLEY, Ethyl Corp.

ALTHOUGH motor gasoline can be used in light aircraft engines in an emergency it is not a satisfactory substitute for unleaded aviation gasoline unless engines are especially designed for it.

If airplanes are to be operated in out-of-the-way places, they must use a fuel that is as widely distributed and as easy to buy as fuel for the motor car. The use of high-test motor gas may sound like the answer, but it isn't as easy as that—as the Army found out when a shortage of aviation fuel forced it to use 80-octane motor transport fuel in liaison-type aircraft. Sticky valves and valve guides, collection of soft carbon in pistons and ring grooves were often the result.

Tests and operation of modified engines indicated that relatively minor changes (counterbored valve guides, changes in valve materials, improved valve seats) would result in increased durability with general freedom from valve sticking. Before combat experience could be obtained on the modified engines, however, 73-octane aviation fuel was again made available in foreign theaters.

Meanwhile, laboratory tests are being conducted by the author's company in cooperation with the AAF and an engine manufacturer to explore more fully the effects of fuel and oil on valve materials and combustion-chamber deposits.

From these tests the author concludes that suitable changes in the metallurgy and design of aircraft engines for personal aircraft can be made to permit satisfactory operation on fuels containing the concentrations of tel permitted in grade 80 all-purpose fuel. Whether these engines and aircraft should be designed to operate satisfactorily on house-brand or premium gasolines, he felt to be debatable. If the obstacle to proper assimilation of tel is overcome, he explained, the major objections to the use of motor fuel then become vapor pressure, volatility, and the variable quality of the fuel in terms of antiknock value and chemical composition.

Dancing was a welcome diversion. More than 250 wives of SAE members attended the Summer Meeting. Women's golf, bridge, keno, and field day sports kept them entertained. Mrs. Paul H. Oberreutter was chairman of the daily ladies' bridge parties, and donated door prizes.

DISCUSSION

Is it worth while trying to adapt aircraft engines to the use of motor fuel? What about increasing the availability of fuel by keeping a supply in one's own backyard? Should the local gas station have an aviation-fuel pump? Answers, or at least varied opinions on these matters, were freely given, debated, and rebutted after Mr. Kerley presented his paper.

Disagreement came first from W. V. Hanley, Standard Oil Co. (Calif.), who held that refueling wasn't the biggest worry of the pilot – next to the weather. He asserted that in the U. S. aviation gas is available within half the gasoline range of most private planes.

The immediate problem, he continued, is due to the fact that the light aircraft engine just will not digest appreciable quantities of lead. He suggested that dedesigners shoot for an engine that takes 91-octane gas with a moderate amount of lead, as has already been proposed by Mac Short, Lockheed Aircraft Corp.

In rebuttal, D. P. Barnard, Standard Oil Co. (Ind.), said that the problem was mainly economic. He felt that only if a fuel is as freely available as motor fuel will it be possible for light airplanes to operate anywhere. Distribution costs, he said, are high per gallon when only small amounts are being distributed.

Aviation and motor fuel are about the same price within a cent or two, Mr. Hanley contended, and gas stations can store aviation fuel as easily as they can store motor fuel.

There are a lot of airports around, Mr. Kerley remarked, but who wants to go 40 miles or so to an airport if one can pick up a supply of fuel closer by? Planes don't have to refuel every time they land, though, L. M. Ferenczi, Standard Oil Development Co., pointed out; they can travel at least 200 miles, and the newer ones 500-600 miles, before needing to refuel.

The high cost of aviation fuel at the airport was reported by R. E. Ellis, Standard Oil Development Co., as being due not to the cost of the fuel to the airport but to the handling charge added to the price to the consumer by the airport.

Low cost delivery to one's own backyard is not a non-paying leader, Dr. Barnard told Mr. Insley, but a service that can easily be continued and expanded. The lower cost possible in this case is due to the elimination of this service charge – the plane owner stores the fuel himself. If the local gas station would handle both aviation and motor fuel, Dr. Barnard continued, fixed costs per gallon would be reduced, because of the increased business. He pointed out that excessive contamination is possible with small containers, whereas the large storage tanks that the local gas station uses are continually being refilled, thus keeping contamination to a minimum.

In reply to another speaker, Mr. Kerley explained that liquid-cooled engines might not have as much trouble with corrosion because of their lower operating temperatures.

The cost of modifying an engine to use motor fuel is $2 per cylinder, exclusive of development costs, Mr. Kerley told A. T. Gregory, Ranger Aircraft Engines.

Answering a question of H. C. Hunter, Gulf Research & Development Co., concerning the heavy end of the volatility curve, Mr. Kerley observed that, although the heavy end – from 50% up – is controversial, during the war operation with a fuel of 285 F, 90% point was quite successful. He admitted that there are still a lot of unknowns in this field that should be investigated.

Only after an engine has completed a CAA test with a particular fuel is that fuel approved for use in the engine, Mr. Gregory explained to Mr. Short, who asked if the engine warranty holds when motor fuel is used in it.

Satisfactory, trouble-free operation is really the factor that should be given most consideration, Mr. Short remarked, for in the final analysis, after the crash it doesn't matter if the fuel was hard or easy to get.

Graphical Solution for the Performance of Continuous-Flow Jet Engines – RAY E. BOLZ, National Advisory Committee for Aeronautics

THE purpose of the paper given by Mr. Bolz was to discuss a series of charts that he had developed to aid in calculating the performance of the jet engine and its individual components over a wide range of engine and operating variables.

The author stressed the point that these charts may even be used successfully by one who has neither theoretical background nor experience in the field.

These charts were shown by the author to constitute a convenient method for determining, for continuous-flow engines: specific thrust; thrust specific fuel consumption; specific power; overall, thermal, and propulsive efficiencies; cross-sectional areas at the diffuser inlet and nozzle outlet associated with the performance of the engines; and a history of the airflow throughout the cycle.

An individual chart is available for each component of the engine, and may be applied to those particular components when they are also used in the gas turbine engine or the compound engine.

The analysis includes the adiabatic efficiencies of the compressor and turbine, diffuser efficiency, combustion efficiency, nozzle efficiency, and momentum pressure loss in the combustion chamber (constant cross-section). The analysis does not predict the relation between airflow, compressor pressure ratio, and compressor and turbine efficiencies, because these are compressor and turbine design characteristics that are different for each engine. Similarly, the analysis does not predict values for combustion efficiency. These characteristics can

The Field Day, Wednesday afternoon, June 5, was masterfully handled by Sam Dickey. Weird contests of undeveloped skills added to the merriment, as nearly 1000 spectators looked on

be assumed, and the optimum design of an engine may then be determined from the charts, which cover all possible designs within the range of variables chosen.

Cyclone 18 Performance in Combat Areas – S. R. KENT, Wright Aeronautical Corp.

OPERATIONAL engineering was reported by Mr. Kent to have played an important part in improving the combat performance of the Cyclone 18 engine, which is used on the B-29.

In March, 1945, he related, the Operational Engineering Section of the Twentieth Air Force Headquarters was created to carry out carefully controlled flight testing in combat areas under combat conditions.

The unit was completely self-sufficient, able to do its own test flying, reduction and analysis of data, and reporting on conclusions to the Headquarters Command.

The initial test program was carried out to obtain a thorough power and fuel-flow calibration of the engine in the B-29 under the climatic conditions prevailing in the Marianas-Japan area. As a result of this series of investigations, a recommendation was made to cruise to Japanese targets at 5000 ft or slightly higher, instead of the 1000-ft altitude that had been the practice.

Many other investigations were carried out thereafter, which resulted in suggestions that made possible an estimated gain in range or payload of about 5-10%, depending on the altitudes and powers selected for each particular mission.

The success of this work is evident from an AAF report that states, "The change in tactics that took place in March, together with more effective cruise control and the existence of Iwo as a friendly base, doubled the bomb-load."

Many specialized studies were also made by the Operational Section, including the job of evaluating comparative performance of the fuel-injection and carburetion equipped airplanes. As a result, it was estimated that a fuel saving of about 2% could reasonably be expected from the use of the fuel-injection engines – a figure that was shown to be correct in actual practice.

DISCUSSION

Power loss resulting from excessive vapor pressure characteristic of some areas in the Pacific was certainly much higher than one would have anticipated, Mr. Gregory remarked. He then asked what its effect on combustion was, particularly compared with water injection in engines. Mr. Kent suggested that the best method of studying this phenomenon would be to photograph the flame. Meanwhile he offered the general explanation that (1) the vapor was displacing an equivalent amount of dry air, (2) it was increasing the fuel/air ratio, since the carburetor metering system delivers fuel in proportion to the total metering suction differential, and (3) it has an effect on combustion itself.

Part of the difference between the effect of this water vapor and the effect of water injection, Harry Gray, International Piston Ring Co., thought was due to the fact that the vapor goes through the carburetor, while the solid water of water injection enters the system after the carburetor.

The carburetor metering system is set up to measure the mass of dry air, Mr. Kent explained to W. E. Lay, University of Michigan, so that the trouble occurs when it also takes in water vapor, which is noncombustible.

Answering a question by F. G. Shoemaker, Detroit Diesel Engine Division, GMC, Mr. Kent said that a mathematical analysis of this problem was beyond the scope of his paper, having already been the subject of other reports.

The Roles of Detonation Waves and Autoignition in Spark-Ignition Engine Knock as Shown by Photographs Taken at 40,000 and 200,000 Frames per Second – CEARCY D. MILLER, National Advisory Committee for Aeronautics

THE adequacy of the autoignition theory for explaining knock was questioned by Mr. Miller, whose study of photographs taken at 40,000 frames per sec has convinced him that a detonation wave, or some phenomenon very much like a detonation wave, actually is involved in the type of knock most frequently encountered in airplane engines.

Briefly, it can be explained as follows: The explosive knock reaction occurs in less that 50 microsec; and autoignition requires for its completion a time interval of an entirely higher order than this 50-microsec figure, even under conditions of severity approaching those of modern aircraft engines.

A further reason for believing that simple autoignition is an inadequate explanation of knock is based on the fact that autoignition can occur without causing marked gas vibrations, which are probably the best known characteristics of knock in the present-day spark-ignition engine.

The author proposes a combination of the detonation wave and autoignition theories of knock, inasmuch as the occurrence of both autoignition and an apparent detonation wave has been demonstrated in knocking engines.

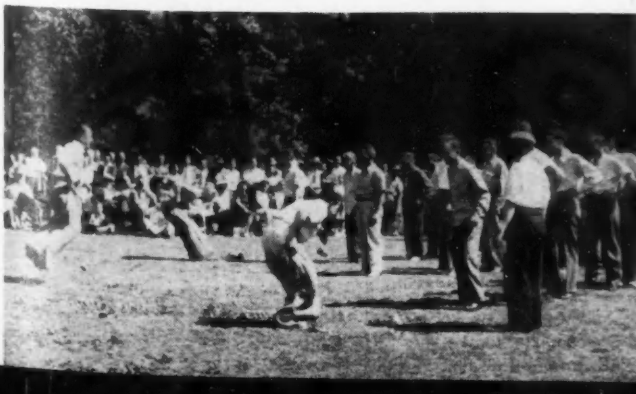
This theory finds ample support in the literature as well as in the photographs taken by Mr. Miller at 40,000 and 200,000 frames per sec.

DISCUSSION

Photographs have been taken that show pinpoint and homogeneous autoignition, but no sign of knock, using the quartz crystal pickup, Mr. Miller replied to a questioner.

Carbon is never seen before the knock occurs, Mr. Miller told O. D. Treiber, Hercules Motor Corp. The carbon that was seen after knock had occurred in the moving pictures shown at the meeting, he said, doesn't change, for whether the carbon shows up as dark or light depends on the speed with which the pictures are taken and the

Field day first prizes went to Mrs. L. S. Martz, W. I. Ford, and M. T. Funkhouser. Second prize winners were Mrs. E. F. Rossman, Mrs. T. H. Risk, and T. J. Nussdorfer, Jr.



amount of light. This carbon, he continued, which is formed within 10 microsec after the detonation wave passes by, unites with the oxygen to a very limited extent, if at all.

The pictures shown by Mr. Miller are a confirmation of conclusions that must be reached by one who considers the known facts, Dr. H. C. Dickinson, National Bureau of Standards stated, before asking about the effect of the thickness of the layer of gases through which the pictures were taken on the results. It is believed, Mr. Miller said, that, under some conditions, burning probably takes place for a short distance behind the flame front; however, the thickness of the burning layer varies for different fuels. For instance, the thickness is much less for benzine than for many other fuels. Nevertheless, there doesn't appear to be any difference in the shape of the flame front for different fuels, he pointed out.

Frequency of vibration as determined from the photographs is of the same order as that shown by pressure indicator cards, Mr. Miller told Mr. Gregory. One can see the gas bouncing back and forth in the photographs, he said, and there can't be much question as to what its effect would be on the pickup.

Possibilities of the Turbo-Jet Powerplant – P. B. TAYLOR and S. T. ROBINSON, Consulting Engineers

(Presented by Mr. Taylor)

THE turbo-jet powerplant makes possible aircraft speeds that just aren't attainable with other powerplants now in use, the authors reported, so that it should have definite possibilities for commercial transport airplanes.

These high speeds are obtained most efficiently at altitudes of 35,000 ft. or above – altitudes that presuppose the use of a pressurized cabin. Scheduled airline operation is now being conducted with aircraft fitted with pressurized cabins.

Blind landing techniques and a new traffic system that will avoid landing delays are essential in a highly developed form. Such tools as radar and television can be used in this connection.

The basic mechanical simplicity of the engine makes its actual operation easy, compared with other types, as a single lever maintains complete control of the engine and auxiliaries. Powerplant vibration is virtually eliminated in the turbo-jet, which is subject only to a high-frequency vibration arising from the compressor and turbine and the roar of the jet. It is indicated but not yet established that for the first time air travel will afford a degree of passenger comfort approached only by automobile travel on a smooth highway.

Of great importance to any commercial operator is the low maintenance cost of the engine, engine checks being completed in about 20% of the time required for a conventional engine. In addition, the authors believe that it will be possible to allow 500 hr or more between overhauls. Cost of fuel will be substantially less than that of high-octane gasoline. Engines have been run on gasoline, kerosene, and fuel oil, the majority using the kerosene, as this fuel seems to meet the principal requirements of high heat content per gallon, ability to flow freely at low temperatures, low cost, and a margin of safety from fire, as compared to gasoline.

Several deficiencies of the turbo-jet powerplant stand out; its poor climb characteristics, its high fuel consumption, and its low performance at low speeds in the range from take-off to flight speed.

In terms of the potential development of these engines, the surface has just been scratched; and in the next few years improvements will be seen in performance and economy that will manifest themselves in still greater utilization and lower operating costs.

DISCUSSION

It seems that we are now substituting new troubles about which we know little for the old troubles that we have been studying for years – just to keep the customer happy, Mr. Nutt remarked.

A transition period in which we take advantage of the turbo-propeller combination before we go to the turbo-jet was foreseen by Ray Kelly, United Air Lines, Inc., who then asked the author about the effect of high altitude fields (especially on a hot day) on the take-off performance of the jet engine.

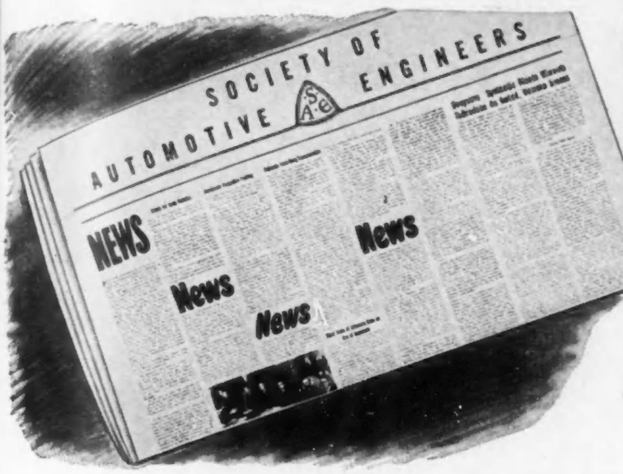
The turbo-prop powerplant is a much more complicated engine to develop than the turbo-jet, so that it appeared to Mr. Taylor unnecessary to take time out on the turbo-prop engine when we can go directly to the simpler mechanism. He admitted that the high-altitude field is a serious problem with the turbo-jet. With the turbo-prop engine this problem does not exist because of the increased power of this engine at altitude.

One system that has been used to increase the power of the turbo-jet in hot weather, he explained, is to add water to the intake of the compressor, thus reducing the temperature of the working medium by evaporation. Mr. Taylor said that a 10-20% increase in power output is accomplished by this method. He believes that in the final analysis, however, it is a problem that must be studied and worked out for each engine.

In reply to W. V. Hanley, Standard Oil Co. (Calif.), Mr. Taylor pointed out that in comparing the performance of the jet engine with the reciprocating engine, one must use a plane that is sufficiently fast and has enough aerodynamic refinements to bring out the performance of the turbo-jet. Thus, the Constellation would not be a good airplane to use, whereas the Rainbow would be an excellent ship for such an analysis. One shouldn't put the jet engine in a plane that has been designed for operation with the reciprocating engine; rather the plane should be designed from the start to take advantage of the turbo-jet engine's own characteristics.

turn to page 48

Old cars and many of their pioneering designers were on hand to celebrate the automotive industry's Golden Jubilee. Thompson Products, Inc., and individuals cooperated in assembling a rare display of early cars



News..
..OF THE SOCIETY

NEW DRAFTING MANUAL Boon to Aero Industry

PUBLICATION last month of the "Aeronautical Drafting Manual," prepared through the fruitful efforts of the SAE Aeronautic Division's Committee S-1, Aeronautical Drafting Manual, marked another milestone in the attainment of a standardized drafting practice for the aircraft industry.

With an ever increasing need for uniformity of expression in and interpretation of drawings among the engine, accessory and propeller manufacturers and the airlines to eliminate ambiguities and incompatibility, Committee S-1 was created in the spring of last year to revise and increase the scope of the "Manual of Aircraft Engine Room Practice" issued in 1941 and revised in 1942 and 1944 by old Committee E-8, Drafting Room Practice. The new manual is expanded to include accessory, propeller and airline drafting practice in addition to a revised engine practice and is now available to the industry.

The intent of the manual is to simplify engineering coordination among the producers and users for greater facility in manufacturing and dispatch of maintenance. The manual was prepared with the criterion in mind that a drawing can be considered completely satisfactory only if it includes all dimensioning, notes, and data necessary for manufacturing departments to completely fabricate and inspect the part so that it functions properly.

Adds New Sections

In attacking the problem of revising and expanding the old manual, the committee, composed of experts in each of the above-mentioned fields and a liaison member of the Society for Promotion of Engineering Education, studied drafting practices of various companies and selected for inclusion in the new manual those features best suited to the needs of the entire industry. The work was divided into 37 separate projects and each was developed vertically by consultation with both producers and users concerned with each phase. As a result of this approach, the new manual not only contains a more detailed treatment of abbreviations, definitions, and dimensioning than did the old manual, but it also includes the following new sections:

1. Forgings
2. Springs
3. Splines
4. Finishes

The section on threads has been expanded to include recommended practices for drilling and tapping holes and a standard on thread relief.

The new section on forging practice is designed to enable the parts manufacturer to prepare a drawing for the forge shop with only those notes and dimensions necessary to produce the forging and facilitate the preparation of the forging dies. Consideration should be given, the manual states, to shape, grain flow lines and draft in preparing the drawing. The designer is cautioned to check the forging drawing against the mechanical drawing to insure sufficient material for finishing or to meet strength requirements.

Springs, as covered in the manual, are treated according to the four main classes of design requirements, namely: no load, one load, two loads and load rate. The drawing for a spring with no load specified should indicate the number of coils, wire diameter, free length and high and low dimensions. For one and two-load springs, the manual recommends, no restrictions should be placed on the spring maker on free length or number of coils other than an approximate description, since he assumes full responsibility in meeting load requirements and should be given enough latitude. The dimensioning of a spring required to meet a rate of load per inch of deflection differs from the above in that a maximum solid length should be specified.

Recommendations Detailed

The added section on splines illustrates the method of delineating external and internal splines as well as the acceptable method of drawing blind splines.

Shown at meeting of SAE Committee S-1, Aeronautical Drafting Manual, are: seated (l. to r.) P. J. Hayes, Jr., American Airlines, Inc.; John G. Perrin, Pratt & Whitney Aircraft; Otto E. Kirchner, chairman, American Airlines, Inc.; Henry F. J. Skarbek, Breeze Corporations, Inc.; M. F. Thorne, Thompson Products, Inc.; and W. B. Billingham, Hamilton Standard Propellers; standing (l. to r.) M. LeRoy Stoner, SAE Staff; John Dzielinski, Ranger Aircraft Engines; Daniel C. Hughes (alternate for Paul V. Richards), Wright Aeronautical Corp.; Prof. S. B. Elrod, Purdue University, liaison from the Society for the Promotion of Engineering Education; Albert E. Gibson, Packard Motor Car Co.; Paul G. Clark, Curtiss-Wright Corp., Propeller Division; and Harry M. Favor, Aeroproducts Division, GMC. C. R. Reynolds, Allison Division, GMC, was not present when photograph was taken

The section on finishes recommends the use of finish marks to indicate that certain surfaces are to be machined and that allowance must be made on a casting or a forging for finishing. Reference is made to other SAE standards for more detailed technical information specifying surface roughness in micro-inches.

The recommended practice for drilling and tapping is included to aid the engineer in designing drilled and tapped parts in accordance with the dictates of practical fabrication and effective performance. One of the practices emphasized is that drilled holes for tapping should be through holes wherever possible. Drills and taps, it is pointed out, should break through squarely and not through a side wall. It is cautioned that tap-drill holes must be dimensioned sufficiently deep to provide clearance for the tap and chips. A table is provided for determining the minimum depth of drilled blind holes and the full or effective thread to insure clearance beyond the end of the male part and tap. National Coarse pitch threads are recommended for castings and all soft metals whereas National Fine pitch threads are recommended for steel parts.

The standard on thread relief presents a procedure for thread relief specification which crystallizes the variance in practice encountered in the field. A table provided for determining internal and external relief diameters is sufficiently flexible to allow for differences in requirements for ground, milled, rolled and die cut threads.

The value of the manual is further enhanced by a number of unique features which greatly facilitate its usage by the designer. For example, it contains a comprehensive, concise, cross-referenced index generally not included in drafting manuals of this type. The Dewey decimal system, used in numbering the pages, simplifies the inclusion of any additions that may be forthcoming without disrupting the numbering sequence. With the view of increasing the flexibility of the manual, a new Supplementary Information Section has been added, permitting the inclusion of individual or company notes.

The committee will continue its aggressive activity in keeping abreast of changes in the aeronautical manufacturing art in order to revise and add to the manual as the need arises. Liaison with other groups participating in development of standard drafting practices such as the American Standards Association is being maintained to apprise the committee of the latest activity and progress in the field.

Present membership of Committee S-1 is as follows: Chairman, O. E. Kirchner, American Airlines, Inc.; W. B. Billingham, Hamilton Standard Propellers; J. Dzielinski, Ranger Aircraft Engines; P. G. Clark, Curtiss-Wright Corp., Propeller Division; Prof. S. B. Elrod, Purdue University; H. M. Favor, Aeroproducts Division, General Motors Corp.; A. E. Gibson, Packard Motor Car Co.; J. G. Perrin, Pratt & Whitney Aircraft, Division of United Aircraft Corp.; H. F. J. Skarbek, Breeze Corporations, Inc.; M. F. Thorne, Thompson Products, Inc.; R. Goodlett, Transcontinental & Western Air, Inc.; P. J. Hayes, Jr., American Airlines, Inc.; C. R. Reynolds, Allison Division, General Motors Corp., and P. V. Richards, Wright Aeronautical Corp. Of great assistance to the committee in its work were former members R. S. Kellogg, Packard Motor Car Co.; L. R. Jones, Bendix Aviation Corp., and W. D. Hazlett, Aeroproducts Division, General Motors Corp.

Rambling Throug Sect

HELD in the plant auditorium of the Inland Division of General Motors Corp., **DAYTON SECTION'S** May 14 meeting featured talks by nine members of Inland's engineering staff. J. D. O'Brien, general manager, gave a brief history of the plant; F. W. Sampson, chief engineer, explained the products on display in the auditorium and introduced the men under his supervision who have been responsible for their development; Stanley Prince, chief metallurgist, gave a brief report on the development of ice trays and ice cube separators; steering wheel problems were outlined by Phil Burner, project engineer on steering wheels; Belleville spring clutches were explained by James Frederick, clutch project engineer. Discussing brake lining problems, Robert Antheil pointed out that brake manufacturers are looking forward to the development of standard brake sizes by SAE. Frank Schneider described the problems involved in the use of plastic materials. Al Everit, project engineer on war products, explained some of the products that were manufactured during the war period, and Herman Wening, project engineer on rubber products, reported that tires of prewar quality may not be expected before the latter part of 1948.

St. Louis Section's May 15 meeting consisted of a field trip to the Wood River Refinery of Shell Oil Co. About 70 members and guests made a 2-hr tour of the refinery, then watched motion pictures relating to petroleum technology

Relative lack of newness in speedway cars and their design was emphasized at **INDIANA SECTION'S** pre-500 mile race meeting, May 16, in a discussion led by Lee Oldfield, president, Laboratory Equipment Corp.; Louis Meyer, a three-time winner of the event; Arthur Sparks, general manager, Mantz-Sparks Tool and

Harlow Hyde, who retires this year after 18 years as Indiana Section secretary, was presented at the Section's last meeting of the season with an engraved gold wrist watch. Ten past-chairmen attended while Chairman Robert C. Wallace made the presentation to Mr. Hyde "in appreciation of his long and untiring services to the Section."

Die Mfg.; and Wilbur Shaw, new president of the Speedway. Single exception is the Fageol "Twin Coach Special," with two engines, one ahead of and one behind the driver. Mr. Shaw pointed out that fast European cars, upon which American racers have been dependent were largely built by governments who, barred from airplane engine production, tested small light-weight high output engines on racing cars to give them a head start for World War II aircraft despite treaty regulations.

Two SAE past-presidents were speakers at **DETROIT SECTION'S** Past-Presidents Night, May 20. B. B. Bachman, vice-president in charge of engineering, presented a paper entitled "Diversification of Truck Use," and A. T. Colwell, Thompson Products, Inc., spoke on "Powering our Future Cars." Shown at the speakers' table in the above photograph are (l. to r.) John J. Wharam, Section vice-chairman for Passenger Car Activity; W. S. James ('44);

Section Reports

J. W. Bateman, Canadian General Electric Co., Ltd., spoke to **CANADIAN SECTION**, April 26, on "Magic of the Spectrum," illustrating his talk with extensive equipment ranging from chemicals with which he produced cold light to

Canadian Section's Retiring Chairman, George J. Beattie, left, presenting the Society's past-chairman certificate to his immediate predecessor, W. A. Wecker

wireless fluorescent tubes seven or eight ft in length. At the Section's May 17 meeting, presentations were made to Past-Chairman W. A. Wecker, president and general manager of General Motors of Canada, to Retiring Chairman George J. Beattie, Auto Electric Service Co., Ltd., and to Section Treasurer F. Martin Buckingham for his ten years' service.

"Tomorrow's Tires" were ably discussed by W. M. Achilles, development engineer of U. S. Rubber Co. at **WASHINGTON SECTION** meeting, May 9. Added feature was the presentation by Frank G. Stewart, president, Standard Automotive Supply Co., Inc., of about 75 pictures of racing cars and cars used on endurance runs in the early 1900's. SAE Past-President Arthur Scaife, one of the original drivers of the Glidden Endurance Tours, related some of his experiences.

The extent to which corrosion will take place depends on the metal and the material with which it reacts, D. R. Frey of the Anderson-Prichard Oil Corp. explained at **MID-CONTINENT SECTION'S** May 10 meeting. Aluminum oxide, for instance, is quite dense and forms a protective film which halts further attack. Speaking on "Chemistry of Crankcase Corrosion," Dr. Frey discussed crankcase corrosion, cold and hot corrosion and corrosion rates, concluding that the most effective film-forming agents are those which contain sulfur and phosphorus in the same molecule; neutralization or acid number is not a measure of corrosiveness, since the amount of acid is less important than the type; and only heavy-duty or 2-104-B type oils offer protection against rust.

Chairman Arch L. Foster next introduced Lewis H. Thomas, manager of Fruehauf Trailer Co.'s tank-trailer division, who spoke on "Trailer Design, Operation and Maintenance," describing new developments and emphasizing the extreme importance of preventive maintenance.

Reliability and performance, not economy, are the controlling factors in the field of off-highway trucks, according to Merrill C. Horine, Mack Mfg. Corp. Speaking before **WESTERN MICHIGAN SECTION,** May 16, on "World's Biggest Trucks – How and Why," he explained that these vehicles operate on very poor roads, are subject to overloading and have relatively little daily mileage. Large engines, preferably diesels, are used, and special suspensions, multiple speed transmission and planetary rear axle drive are necessary. Size also necessitates special operator aids and controls . . . road vision and general handling problems of these large trucks, Mr. Horine said, have brought about some unconventional and interesting designing.

Mr. Colwell ('41); R. R. Teetor ('36); D. G. Roos ('34); A. J. Scaife ('32); J. H. Hunt ('27); Mr. Bachman ('22); L. Ray Buckendale ('46); R. J. Waterbury, Detroit Section chairman; J. A. C. Warner, secretary and general manager of SAE; H. W. Alden ('12); W. R. Strickland ('29); H. C. Dickinson ('33); W. B. Stout ('35); H. T. Woolson ('37); Arthur Nutt ('40); J. M. Crawford ('45); and E. P. Lamb, vice-chairman for Truck and Bus Activity.

Aero Alloy Steel Purchasing Eased

IMMEDIATE consideration is being given by the SAE Low Alloy Steel Committee of the Aeronautical Material Specifications Subdivision to alleviation of difficulties encountered by the aircraft industry in warehouse purchasing of AMS low alloy steels. Committee action is under way to coordinate the problem of suppliers and users to establish a minimum number of steels to be used.

Paramount cause of these difficulties facing the aircraft industry is the procurement of AMS steels in quantities less than minimum mill requirements which normally involves warehouse purchases. Warehouses, however, find it economically impossible to stock all of the AMS steels in all the possible sizes that might be desired. Warehouse representatives present at a recent meeting pointed out the necessity of limiting the number of materials and sizes to be obtained from the warehouses.

Following this suggestion, the Committee tentatively determined that the following 9 steels have the greatest preference and usage:

AMS 6260B	AMS 6320B
AMS 6270C	AMS 6322B
AMS 6272C	AMS 6415B
AMS 6280A	AMS 6440B
AMS 6470B	

Although material conforming to AMS 6415B, 6440B, and 6470B is already available from the warehouses, warehouse representatives indicated willingness to cooperate in stocking material conforming to the other six specifications if realistic recommendations were presented reducing preferable sizes to a minimum.

A survey will be conducted of the committee members to advise them of the critical nature of the problem and the position of the warehouses and to obtain recommendations concerning minimum sizes required.

Another problem discussed by the Committee is the revision of AMS 6260B, 6270C, and 6274C, triple alloy series for bars and forgings conforming with AMS 9310, 8614, and 8619 compositions. Chairman B. Clements, Wright Aeronautical Corp., will revise these three specifications to include requirements for mechanical tubing and submit them for approval, through letter ballot, to the committee members and interested suppliers.

Aero Hydraulics Aid Pledged to Services

CONTINUED industry-government cooperation was assured at the initial peacetime meeting of the SAE and industry committees on aircraft hydraulic and pneumatic installations and representatives of the military services. Highlighting the conference, sponsored by SAE Committee A-6, Aircraft Hydraulic and Pneumatic Equipment and the National Aircraft Standards Committee group on installations, was the launching of varied projects for hydraulic and pneumatic improvements.

Matters discussed ranged from revision of existent AN specifications on equipment such as plastic parts for hydraulic equipment and hydraulic shuttle valves to prepa-

ration of specifications for newly developed items, among which is a 3000 psi power-driven hydraulic pump. An added treat for the conferees were presentations of reports covering hydraulic testing with electrical devices and control surface booster systems.

Recommended revisions of the plastic parts specification, AN-P-78, were submitted by a subcommittee under the chairmanship of F. O. Hosterman, of Lockheed Aircraft Corp. Changes concurred in by the joint committee included: elimination of new qualification tests where similar parts of the same material have already been qualified; less severe water immersion tests to obtain more consistent results, and a revised permanent set test to duplicate, as nearly as possible, service conditions.

Shuttle Valves Reviewed

Recommended changes to hydraulic shuttle valve specification, AN-V-3a, were obtained through a survey conducted in the industry. Modifications, sanctioned by the Committee and agreed upon by the service representatives present, included the use of non-standard seals – provided they have a life equal to that of the entire valve assembly – because standard seals were found to be unsatisfactory. Port locations were revised and all reference to port designations in the specification eliminated. More practical test procedures were prescribed and a provision made to test each unit for shuttling pressure and leakage at 5 psi.

Another specification revised, AN-R-22, Hydraulic Packing Back-Up Rings, contained a provision requiring a 15% grease content for leather back-up rings which was considered unsatisfactory by several of the companies. Agreement was reached that the specification be revised to require only a 3 to 10% grease content.

3000 psi Pump Planned

A new task underway is the drafting of a performance specification for 3000 psi hydraulic pumps. The Army and Navy have advised the Committee that the new pump envelope will be based on the one for the 1500 psi pump and that the capacities are to be the same, although it is understood that a 10% leeway in capacity will be acceptable. Present pads, however, are not considered suitable to handle these capacities at 3000 psi and the Engine Technical Committee of the Aircraft Industries Association has been coordinating engine manufacturers' recommendations on this matter. The specification will be coordinated with the industry, when the final draft is available, through SAE Committee A-1, Aircraft Pumps.

Another proposed specification under consideration involves a differential air brake valve. In its present form, the proposal specifies that the pressure range be 0-1500 psi and that the mounting, when installed, shall have sufficient strength and stability to withstand 150% of the wrench torque loads required for making the tube connections. The tentative proposal is to be submitted to manufacturers for comment and, if found acceptable, transmitted to the Working Committee of the Aeronautical Board.

A problem facing the industry is the perfection of an improved fitting for the 3000 psi system to replace fittings for flared tubing which are troublesome to install and maintain. One design possibility proposed for standardization is the Ermeto fitting. Majority opinion deemed it advisable to postpone this consideration until industry has had further experience with these fittings, although limited usage to date has proven them superior to present AN fittings.

Electrical Testing Precise

A thorough report revealing that hydraulic testing with electrical devices is more precise than conventional pressure gages was presented by a subcommittee consisting of Mr. Hosterman, W. C. Trautman, Bendix Aviation Corp., and R. C. Bergh, Republic Aviation Corp. Equipment found necessary by the subcommittee to satisfy requirements of such tests are a pickup device, power source, amplifier, demodulator, and a recording indicator. Of these, the items which can be varied and require detailed consideration are the pickup device and recording unit.

Much promise is held out for this technique as the precise measurements possible should provide an incentive to improve designs by materially reducing those pressure peaks with attendant shock, vibration, and noise level. The procedure is still new and much remains to be done in the development of the equipment before the method should be specified in detail, it was reported.

Utilization of aircraft control surface booster systems and the possibility of using hydraulic dampeners to eliminate surface control vibration and flutters was discussed at length by J. E. Fergusen, Transcontinental & Western Air, Inc. The problem of designing for suitable pilot control effort becomes more difficult as aircraft size and speed increase and forces on the flight system become greater. Mr. Fergusen reported that the airlines have had wide experience with various types of remote control systems and all activities contacted noted the superiority of hydraulics over other means of power transmission for dependability. Other features of several hydraulic booster systems in use commended by one airline are safety and simplicity for ease of overhaul and line maintenance.

SAE Handbook Expanded On Brazing and Welding

PREPARATION of general information on copper and silver brazing alloys and iron and steel arc-welding electrodes for inclusion in the SAE Handbook by Joint Subdivision VI, Metal Joining Materials, of the SAE Non-Ferrous Metals and Iron and Steel Committees, denotes completion of its initial assignment.

Organized in 1944, under chairmanship

The balance sheet as of December 31, 1945, and the condensed operating statement for the year ending on that date, of the Coordinating Research Council, Inc., is presented below. The American Petroleum Institute and the Society of Automotive Engineers, the two sustaining members of the Corporation, share equally in its ownership:

Balance Sheet
as of December 31, 1945

Assets		Liabilities	
Cash	$63,404.77	Reserves	$63,404.77

Note: The above balance sheet does not include the following assets and liabilities:

Assets:	
Accounts receivable	$2,230.98
Stationery inventory	732.04
Postage	343.96
Forms and procedures	1,227.78
Total	4,534.76
Liabilities:	
Accounts payable	250.62
Net assets	$4,284.14

Operating Statement
Year ending December 31, 1945

Income		
Sustaining Members		
American Petroleum Institute	**$ 35,000.00**	
Society of Automotive Engineers	**35,000.00**	
Grants from Industry	**16,000.00**	
Army Ordnance*	**4,584.53**	
Other Income	**4,020.13**	
Total	**$ 94,604.66**	$ 94,604.66
Expense		
Salaries	**$ 57,409.25**	
Operating Expenses	**24,187.48**	
Total	**$ 81,596.73**	81,596.73
Net Income		$ 13,007.93
Reserves as of January 1, 1945		50,396.84
Reserves as of December 31, 1945		$ 63,404.77

* For services rendered in 1944.

of W. C. Schulte, Curtiss-Wright Corp., Propeller Division, the joint subdivision was delegated the responsibility of preparing a new group of data for the SAE Handbook on ferrous and non-ferrous metal-joining materials. Proposals on brazing alloys and arc-welding electrodes have been submitted by the group to the parent committees for approval and to the SAE Technical Board for adoption. The arc-welding electrode classification was prepared to serve as a descriptive reference or guide to the complete American Welding Society-American Society for Testing Materials specifications.

Brazing, the proposed general information defines, is a metal-joining process wherein the filler material is a non-ferrous metal or alloy – either predominantly copper or silver – whose melting point is higher than 1000 F, but lower than the metals or alloys being joined. Brazing of ferrous alloys, copper, brass, and bronze can be successfully accomplished with copper base alloys. Silver brazing alloys, it is further stated, are desirable for properties of high shock and vibration resistance at ordinary temperatures, free-flowing capillary action, and excellent resistance to corrosion.

Included in the general information are tables for both copper and silver brazing alloys giving composition and physical properties of commonly used alloys. Selection of the proper alloy, dependent upon its own characteristics and required properties of the joint, is simplified by explanatory notes relating the use of each type of alloy.

Additionally, the best method for obtaining best results in brazing application is outlined. For example, to produce a satisfactory brazed joint, the procedure advises, the parts should be thoroughly cleaned, removing oxides, scale, grease, and dirt. A flux is recommended for the alloy as well as the joint to insure best results. The technique of heating by torch and application of supporting jigs is explicitly described.

Electrodes Classified

Tremendous increase in application of metal arc-welding has brought about a wide variety of electrodes bearing numerous trade names, complicating selection of the right electrode for the job by the consumer. A specification, prepared by an AWS-ASTM committee, has been briefed by the SAE Metal Joining Materials Subdivision for inclusion in the SAE Handbook. This same specification has proved acceptable to producers and users and is understood to cover 90% of electrodes produced today.

Basic electrode specifications are given in terms of the following characteristics which determine electrode usability for various positions and types of application: current and voltage range, current characteristics – a-c or d-c and straight or reversed polarity – involved, weld metal fluidity, mechanical characteristics of deposited weld metal, and ability to render a sound weld and satisfactory profile weld. The numbering system for identifying the electrodes indicates the minimum allowable tensile strength of the weld in the stress-relieved condition.

Tables, essential data, and descriptive information, as presented in the proposed guide to AWS-ASTM specifications, is a useful reference for the electrode user interested in quickly and accurately selecting the proper electrode for the particular arc-welding process he intends to employ. Incorporation of the material in the SAE Handbook provides an added convenience to the welding engineer and other technicians interested in arc-welding.

National Pacific Coast Meeting

August 22 - 24

TRANSPORTATION and MAINTENANCE

- SEVEN technical papers on Passenger Cars, Automatic Transmissions, Engines, Bearings, Lubricants, Logging Trucks and Buses
- GUIDED INDUSTRIAL TOURS have been scheduled
- GOLF planned for Saturday afternoon
- DINNER, with SAE President L. Ray Buckendale, and DANCE

New Washington Hotel, Seattle, Wash.

Serving with Mr. Schulte on the Metal Joining Materials Subdivision, responsible for preparation of the concise yet comprehensive sections on brazing alloys and arc-welding electrode classification, are: H. D. Bubb, Jr., Thompson Products Inc.; J. M. Diebold, General Motors Corp.; H. Sparks, Chrysler Corp.; E. C. Smith, Republic Steel Corp.; R. W. White, U. S. Army Ordnance; R. H. Terry, General Motors Corp.; J. Gurski, Ford Motor Co.; A. M. Setapen, Handy & Harman, and W. C. Lang, Chrysler Corp.

SAE Committee Promotes Motoring Safety, Overcomes Bumper Lock & Structural Defects

FACTS developed by the SAE Technical Board's Bumper Standardization Committee indicate that it will be entirely possible for designers and engineers so to locate bumpers and bumper guards on passenger cars, station wagons and half-ton trucks that the locking of front bumper guards and rear bumpers during normal operation in congested traffic and in parking lots can be eliminated or at least greatly reduced.

It was agreed that the critical points to be considered in bumper heights are the top of the front bumper guards and the bottom of the rear bumper bars.

Modern cooling systems with their low radiators are one of the difficulties which militate against raising front bumpers the necessary amount to eliminate locking with rear bumpers, while trunk doors and body overhang pretty much govern the height of the rear bumpers. Styling problems also raise objections to changing the height of either front or rear bumper.

However, the committee believes that the difficulties can be largely overcome through changes in design and that an effort should be made to give stylists something to work toward as a recommended practice.

Truck Bumper Heights Vary

Committee members were unanimous in their belief that no uniform practice is possible with trucks above the half-ton rating. The wide variance in use requirements which controls truck design makes any uniformity of bumper heights hopeless.

A tabulation of bumper data from 24 truck manufacturers shows that front bumper heights vary from 21 to 43 in. and frame heights in the rear vary from 17 to 58 in. Tire sizes depend upon truck capacity. Rear bumpers are impossible on dump trucks, as well as on many other types such as those with tail gates.

Wheelbases of one and one-half ton trucks alone vary from 84 to 200 in. with corresponding differences in rear overhang. Tire sizes on this class of truck range from 7.50 to 10.50 in.

It is also pointed out that heavy trucks

are not frequently parked in congested lots nor along curbs. Also, they can and do avoid congested traffic conditions to a far greater extent than passenger cars, either by choice or legal requirements, thus constituting much less of a hazard from the standpoint of bumper locking.

Variables regardless of truck capacity which make uniform truck bumper heights impracticable are wheelbases, which range from 84 to 250 in.; overhangs beyond rear axles varying from 33 to 100 in., and up and down frame or platform travel due to spring action between load and no-load conditions which may be as much as 8 to 10 in. Tires range from 6.00-16 duals to 14.00-24 duals with a difference in rolling radii up to 1 ft. Frame depths vary as much as 6 in. Six-wheel trucks with dual rear axles have up to 5 or 6 in. more riding clearance than single axles to provide for the articulating action of the two axles.

Offer Possibilities

Having straight fronts, buses lend themselves much more than trucks to uniformity of bumper heights, while transit and cross country buses may also be able to meet height requirements in the rear. Although bus data are just being gathered, informal opinions of bus men on the committee are that transit buses may be able to meet the recommended practice which the committee hopes to establish for passenger cars.

The situation with school buses, however, is much the same as it is with trucks due chiefly to the great overhang of bodies in the rear, which in some cases is 100 in. This prevents locating rear bumpers anywhere nearly as low as those on passenger cars because of the high clearance requirements of the overhang and the fact that school buses operate over country dirt roads with high centers, bumps and holes.

EXTENSIVE comparative tests of the strength characteristics of various bumpers as well as an analysis of the methods employed by the manufacturers in testing their own bumpers has been made by the SAE Bumper Standardization Committee. Most generally used procedures are the Olsen Load Test, Impact Test using drop weight and hook, and pendulum weight test.

Because of various opinions covering the requirements of the bumper, the many design factors and other conditions involved, the committee does not plan to set up definite limitations on bumper strength. The following general conclusions, however, may be drawn, according to the committee:

1. It is considered a reasonable requirement that a bumper should not fold up or take appreciable permanent set under a 2 mph impact of the car.

2. However, a limitation on the maximum strength of the bumper could also be considered in the interest of protecting the passengers from severe impact in the case of collision. It might be an excellent idea to have the bumper actually fail under high impact loads to absorb as much energy as possible, thereby easing in so far as possible the high deceleration that accompanies the severe impact.

3. Due to differences in weights and sizes of cars, which means lesser foot pounds for lighter cars, it probably is not wise to try to set up a code calling for certain properties for all bumpers alike.

Following extensive guillotine drop tests conducted by the committee at the Standard Steel Spring Co., Coraopolis, Ohio, its trend of thought is:

1. It appears desirable that bumper secondary back bars be so designed that they form an arch bar between the frame ends of the car and the bumper face plate. This arch bar should be placed as close as possible to the bumper face plate and attached at least two places to same. It will act as a structural member under impact and hold down excessive deflection underlying impacts. It should be made from high carbon steel and fully heat treated.

2. Secondary back bar brackets which usually run from the frame to the outer portion of the face plates should have sufficient bracing action and should be made from steel thick enough in gage and wide enough to resist vertical bending and horizontal impact. These bars should be made preferably of high carbon steel fully heat treated. Riveting of the arch bar, noted above, and brackets add to the strength of the bumper unit.

3. The use of hardened steel in the face plates gives better results as to deflection and gives much better performance as regards permanent set of bumpers under impact. Denting of the face bar under concentrated loads is decreased very much by the use of hardened face plates.

4. The use of bumper guards relatively closely spaced has some advantage in distributing loads under impact, provided such loads are applied to each guard simultaneously.

5. There is distinct advantage in face plate sections which are turned in at the edges and at right angles to the surface. This increases the resistance of such face plates to deformation and provides resistance to elastic instability of such sections at the edges.

6. One piece bumpers appear superior from a strength standpoint to multipiece bumpers, due to the fact that the multipiece bumpers, rivets, bolts, etc., become points of stress concentration. Invariably these rivets shear off, the steel cracks or dents, or the bolts pull through the steel sections under impact.

7. As far as deflection, permanent set, and dentability are concerned, the following facts were observed during our tests:

Hardness of the face plates from 35 Rockwell C to 42 Rockwell C resists denting very well. Face plates with this hardness show slightly better deflection characteristics than softer bars. Face plates of this hardness show permanent set characteristics which are considerably better than softer bars.

It was found that face plates with hardness from 72 Rockwell B to 86 Rockwell B dent easily and have lower deflection and permanent set characteristics.

8. It is important that where heat treating is involved in face plates that these face plates be heat treated in a manner similar to isothermal quenching methods thus providing uniform hardness and grain structure throughout the plate.

9. There is a direct relation in the efficiency of the performance of the bumper face plates and the metallographic structure of the steel used. This relation shows that high hardness combined with freedom from ferritic structure produces the best results. Low hardness combined with annealed or normalized structure results in inferior characteristics.

10. It is interesting to note that from a permanent set and deflection standpoint, most of the bumpers stand up fairly well for the first 200 ft-lb. However, the point of failure on the best bumper seemed to be around 2000 ft-lb. The committee feels that stress should be laid to improve bumpers so that from a permanent set and deflection standpoint they would stand up well at a minimum of about 600 ft-lb and that the point of failure should be established around 1800 to 2000 ft-lb.

11. Dentability seems to be purely a matter of function of the hardness of the steel in the face plate and should be best determined by each car manufacturer.

STANDARDIZATION of License Plates in Sight

FORTY-EIGHT states have used 48 different sizes, styles and forms of automobile license plates and thereby contributed to the headaches of designers and enforcement officers alike.

The most encouraging sign that some uniformity of motor vehicle designation may be just around the corner is an informal request received by the SAE Technical Board from the Engineering Liaison Committee of the Automobile Manufacturers Association and the Engineering Committee of the American Association of Motor Vehicle Administrators asking for SAE assistance in standardizing license plate mountings.

The SAE Bumper Heights Committee, already in action trying to establish some uniformity in the heights of bumpers, has been given this new license plate assignment.

License plate standardization has been a subject of discussion by the Engineering Liaison Committee of the AMA and by the Engineering Liaison Committee of the AAMVA for a number of years. The administrators' committee would like to have the automobile engineers indicate what standards on mounting would be acceptable to the automobile industry.

It is understood that the administrators believe that it will not be possible to standardize on a single plate for all states, but that agreement can probably be reached on a standard height and a maximum length. States which do not require too many numbers can use a shorter plate. Also states using larger numbers might use shorter plates for the smaller numbers which are issued.

It has been suggested that the size and location of the holes for the fastening bolts can be standardized, also that some method of clamping a plate at the edges may prove possible. The latter may require limits on the dimensions of any bead about the edge. Limits on the dimensions of clamps or of washers may prove desirable to prevent obscuring essential figures on the plates.

It is the desire of the AAMVA to have the SAE committee explore the question of license plate mountings and parallel the working of the AAMVA committee on the standardization of the plates themselves.

George L. McCain, Chrysler Corp., and chairman of the Bumper Heights Committee has appointed the following to work with him on the license plate standardization problem: Wilbur Cross, motor vehicle administrator, State of Connecticut, Hartford; H. I. Sole, Packard Motor Car Co.; William J. Tell, Cadillac Motor Car Division, General Motors Corp.; and J. J. Wharam, Ford Motor Co.

Student Branch News

Detroit Institute of Technology

THE annual banquet of the SAE Student Branch of the Detroit Institute of Technology was held on May 15 at the Rackham Memorial Building, Detroit.

Walter Mueller, the chairman, introduced Mr. McKnight, Director of Education of the Detroit Institute of Technology. Mr. McKnight outlined the various achievements made by the school during its existence, and expressed his pride in its accomplishments over the years.

L. M. Ball, Director of Electronics Laboratory, Chrysler Corp., spoke on the "Strain Gages." He outlined many practical uses of the strain gage in industry, as well as some of its phenomena; at the same time he showed vivid illustrations by photographic and diagrammatic slides.

Paul Huber, student chairman of the Detroit Section, spoke of the excellent work which the SAE Student Branch of the Detroit Institute of Technology had done in the past, and at the same time he was glad to present the SAE Student Branch Charter to Prof. L. L. Henry, SAE faculty adviser of the Detroit Institute of Technology. Professor Henry gladly accepted the Charter and said he felt certain that the members will do their utmost to continue their work to make the SAE Branch a more powerful and effective organization.

Professor Henry next presented the Charter to Ralph Marinelli, the newly elected Chairman for the succeeding year. Marinelli then introduced the new administrative body, William Maddock, vice-chairman; Michael Loncar, secretary; John Bruno, treasurer.

Massachusetts Institute of Technology

On May 21, the Massachusetts Institute of Technology Student Branch of SAE made a very interesting visit to the Mathewson Machine Works at Quincy, Mass.

L. W. Huer acted as student guide and the main topics of interest were outboard propulsion units, mattress machines, and a special type scale.

The outboard propulsion units, produced under the trade name of Murray and Tregurtha, Inc., were designed and developed for the Navy, and saw considerable use in putting heavy equipment ashore in various invasions during the war. These units are coated with a rust preventive and are carefully wrapped to prevent corrosion of vital parts.

Under the trade name of United Mattress Machine Co. is produced a mattress buttoning machine which consists of a plunger which on the upstroke, laces the cord on the top side of the mattress, and on the downstroke, laces the cord on the bottom side. This machine has a ready world market.

Another interesting machine is the special type scale, made for the Treasury Department, used to weigh sugar. All operations are automatic and no adjustments are necessary.

Several points about the plant layout are noteworthy. Parts are made up in batches by experienced machine operators who set up their own work except in complicated jobs. The final assembly is on a mass production basis.

The following officers were elected at the May 29 meeting of the Branch for the coming year: Thomas G. Zsembik, chairman; Guido J. Frassinelli, vice-chairman; Betty Bunte, secretary-treasurer.

Ohio State University

On May 29 the Ohio State University SAE Student Branch elected officers for the coming year. The results were as follows: Paul Morgan, chairman; Richard Graham, vice-chairman; Frank Troglia, secretary-treasurer.

Oregon State College

A joint dinner meeting of the Oregon State College SAE Student Branch and the Oregon Section of SAE was held at the Benton Hotel, Corvallis, Oregon, on May 17. W. V. Hanley, O.S.U. '33, now assistant manager, Aviation Division, Standard Oil Co. of California, was the featured speaker. The topic of his paper was "Postwar Private Plane Flying."

James Lewis, chairman of the Student Branch, presented a paper on "Analysis of Postwar Motor Fuels," which was prepared from his investigations. For his paper, the only one written this year, the Oregon Section presented him with a $20 check.

Purdue University

The Purdue University SAE Student Branch held a meeting on May 23, at which time three sound films, furnished by the General Motors Public Relations Dept., were shown. The subjects were, "Caravan," "Futurama," and "Lest We Forget."

On May 28, R. R. Faller, Ethyl Corp. Research Laboratories in Detroit, presented a lecture on automotive fuels and engines. By means of slides, a demonstration with a portable single cylinder test engine, and an interesting lecture, Mr. Faller presented the fundamental principles of high-compression engine development. He also pointed out those problems which remain unsolved, and discussed several possibilities for future development.

University of Wisconsin

The SAE Student Branch at the University of Wisconsin was a guest of the Milwaukee Section at a dinner meeting held on April 16 at Tripp Commons of the Memorial Union.

Forest Nagler, chief engineer of Allis-Chalmers Co., was the main speaker of the evening. His talk was on "Choosing the Material for the Job," which was illustrated with slides and slow-motion pictures.

A regular business meeting of the University of Wisconsin SAE Student Branch was held on May 14 at the Union Building. A nominating committee for the election of officers for the new term was appointed.

Mr. Shurts, a guest of the evening, who had been to Europe recently to inspect Axis equipment, spoke on hydraulic couplings, and hydraulic torque converters. Following his talk, a color movie was shown which illustrated typical commercial applications of the fluid couplings. This brought forth more detailed questions which Mr. Shurts answered by referring to his breakdown samples.

SAE Coming Events

Meeting	Date	City	Hotel
West Coast Transportation & Maintenance	Aug. 22-24	Seattle	New Washington
Tractor	Sept. 11-12	Milwaukee	Hotel Schroeder
Aeronautic Meeting and Aircraft Engineering Display	Oct. 3-5	Los Angeles	The Biltmore
Transportation & Maintenance	Oct. 16-17	Chicago	Knickerbocker
Fuels & Lubricants	Nov. 7-8	Tulsa	Mayo
Air Transport Engineering	Dec. 2-4	Chicago	Edgewater Beach

Army Seeks U. S. Questions To Sift Nazi Techniques

THE Society of Automotive Engineers has been asked by the War Department to cooperate with its new organization in Germany which is studying engineering and technical developments in the interest of making this information available to American industry.

The Army's staff plans to go into German factories and laboratories to search for answers to questions posed by American engineers.

Engineers who have specific questions regarding design, materials, and processes are asked to write to Don Blanchard, SAE Technical Board secretary, at SAE Headquarters, 29 West 39 St., New York 18, N. Y., who will transmit them to the War Department.

Improvements and New Problems Emerge from Long Turbine Study

Excerpts from paper

by E. M. PHILLIPS

General Electric Co.

■ Dayton, Oct. 31

(*Paper entitled "Gas Turbine Metallurgy"*)

SUCCESSFUL development of the gas turbine for aircraft propulsion has occupied but a short period of intensified effort. However, this present development is based upon the thoughts, the studies, the trials and the experiences of many years.

Gas turbine studies and experiments have been handicapped by lack of proper metallurgical development to permit design of an effective gas turbine powerplant. There were no materials developed which were capable of withstanding the high temperatures necessary for efficient operation.

Turbine Principles

Fig. 1 shows a simple gas turbine in diagrammatic form. Air, in sufficient volume, enters the compressor at the left and is raised in pressure to a level satisfactory for efficient later turbine expansion. During this compression, the air decreases in volume, but is raised in temperature. The air next passes into the combustion chamber where fuel is added through a spray nozzle and is burned, thus increasing the volume and temperature and raising the energy level. The actual increase in temperature is dependent upon the F/A ratio. Excess air above that required for combustion is necessary to limit the temperature as dictated by the materials available. The hot gases are then passed through the turbine, consisting of one or more stages of expanding nozzles and buckets, where the temperature and the pressure are lowered and work is extracted from the hot gases. Useful work, indicated as output at the extreme left, is available by the excess of turbine output above the power taken to drive the compressor plus losses in the combustion chamber and passages. Useful work can be in the form of electrical or mechanical power.

Fig. 2 illustrates the system where useful work is obtained by means of the thrust from the hot gas jet passing through a restriction at the end of the exhaust passage which follows the last row of buckets.

Fig. 3 illustrates the system where useful work is obtained by a propeller or fan supplemented by the thrust from the hot gas jet.

Since useful work is obtained only by the excess of the output of the turbine above the work of compression plus the combustion losses, it is essential that the efficiency of the various elements be as high as possible. High overall efficiency requires that the temperatures of the hot combustion gases be high. Development of a successful gas turbine was not possible at as early a date as that of the reciprocating gas engine because of the difference in metal temperature.

Between Wars and during the early part of World War II, improvement in materials was made possible by the fine cooperation of steel manufacturers who accepted the challenge to develop and supply materials that would withstand the temperatures not only theoretically expected but also actually obtained under emergency flight conditions. Successive changes were made as better materials became available and as experience indicated the need for better high temperature resistance. This need was brought about in part by the increase in rating and partly by the increase in temperature of the hot gases from the engine.

Selection of Material

In the selection of a material many conditions are given consideration. Not the least of these is the ability to obtain consistent results in actual application. Ease of maintaining processing control is an exceedingly important item, which may in many cases outweigh other considerations.

Soon after we first applied the vacuum high speed bursting test, also at low temperatures, it was realized that results at temperature and under a longer period of time did not necessarily agree with those obtained by the short-time tests at room temperature.

Thus was born the era of long-time testing at various temperatures with the increased complication in testing. Test machines were tied up for many hours or even months. Since types of treatments used and methods of processing are so numerous that testing of all combinations would be prohibitive and results would be delayed beyond all reason, much preliminary study and testing is required so that with a minimum of high temperature creep and rupture testing, satisfactory results can be assured.

In addition to creep and rupture testing, other types of tests are necessary. Behavior under vibration conditions must be investigated. Effects of variable stress and of shock stresses must be studied. Notch brittleness resulting from corrosion or erosion must be determined. Effects of varied temperature must also be investigated. Resistance to these conditions is an important consideration in a material. It is important that materials in actual use be checked in the actual atmosphere to be met in service, since the effect of this atmosphere may be very different from that of the standard atmosphere.

There is considerable material investigation and testing prior to the determination of the suitability of a material for high temperature, high stress service. The actual amount of testing is many times that indicated since many different materials must be checked to obtain a satisfactory one, and then many more must be checked to obtain the maximum of improvement in the chosen material.

However, this vast amount of testing is but preliminary and only fulfils the purpose of furnishing to the metallurgist and designing engineer the information needed to make a satisfactory choice of material which will meet the requirements of the design. Actual proof testing is still ahead. Many extensive accelerated life tests duplicating the most severe conditions to be met in service are necessary before the designer can be assured of successful operation in actual service. Every effort must be made to determine, in advance, the extreme conditions which may be met.

As a result of these tests, subject to the confirmation of flight tests, inspection and overhaul periods and replacement schedules must be set up. In general, the periods between inspection and overhaul must be gradually lengthened or the performance improved.

Design Problems

The material problem is of great importance for without materials capable of withstanding high stresses in conjunction with high temperatures, efficient gas turbine plants would not be possible. However, there are also several important mechanical design considerations which, if neglected, may spell disaster.

In operation at high temperature, materials are subject to distortion. Unless the materials structure is absolutely uniform and unless stresses within the materials are evenly distributed and well balanced, parts will warp and distort as creep takes place. Stresses may be introduced into materials by heat treatments or by other means such as machining or welding. These may be relieved in part by the application of strain relief heat treatments.

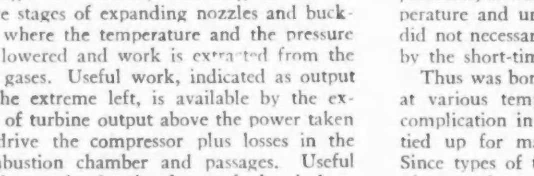


Fig. 1 – Simple gas turbine in diagrammatic form

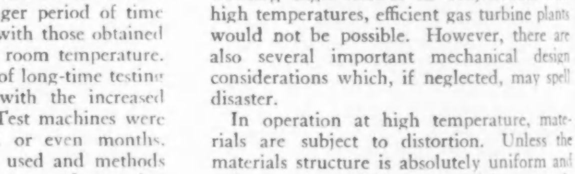


Fig. 2 – Gas turbine system with the addition of thrust from hot gas jet passing through restriction at end of exhaust passage

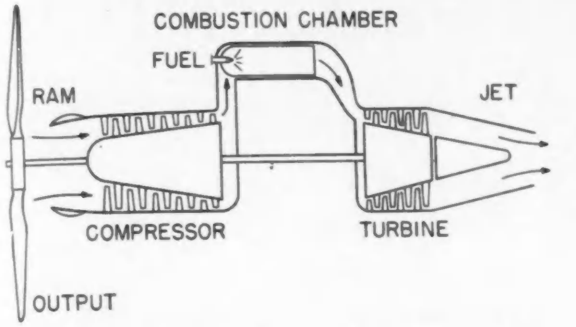


Fig. 3 – Thrust from hot gas jet supplements fan or propeller to produce useful work

Parts rotating at high speed must be carefully and accurately balanced and must be so designed and constructed that balance will be maintained under service conditions. Parts cannot be permitted to shift during operation, movements must be perfectly elastic. Inelastic changes due to friction between parts must be avoided. Units must be so supported that strains are not put onto the unit so as to distort the rotating parts.

In conclusion, in building gas turbines or any other high speed high temperature apparatus, successful results can only be assured by careful and painstaking attention to every minute detail of design, of processing, of materials, and of manufacture.

■ ■ ■

Economic Variables Determine Design of Aircraft Interiors

Digest of paper

by R. W. RUMMEL

Transcontinental & Western Air, Inc.

■ Chicago, Dec. 5

(*Paper entitled "Aircraft Interiors from the Airlines' Viewpoint"*)

PRIMARY consideration in aircraft interior design is the service function the aircraft is to perform, Mr. Rummel announced. Selection of the airplane's job – quantity and type of payload, range, speed, operating cost and resultant fare structure, and overall utility – are dominant factors in conception of the interior.

Starting point in the design is determination of the type of service to be rendered. For example, in design of the most efficient and attractive cargo plane, factors known should be: average load, load density, distance of haul, and permissible fare for transporting the package that distance. With these requirements established, the designer can lay out the fuselage size and shape, bearing in mind loading and unloading characteristics as well as power requirements to best meet performance and cost specifications.

It can, therefore, be seen that selection of a suitable plane interior from the airline viewpoint involves interests in many departments. Compromises must be made on controversial issues such as sleeper versus dayplane, low density arrangement with attendant high passenger-mile costs as opposed to high density and low costs, and competitive advantage of high luxury standard during periods of low traffic potential as compared with weight.

Having determined the type of airplane being designed, Mr. Rummel stressed the two important decisions to be made in design of details. First is determination of the passenger load-cargo weight ratio; the two extremes are the passenger plane and the cargo ship. The second item is the proper comfort standard. Is it to be bus, rail coach, or pullman type of service?

Decisions regarding passenger-cargo weight and space ratio embrace the extent and relationship of comfort standard to scheduling, loading, and nature of anticipated cargo. Assuming the load carrying ability of present day planes exceeds the ability of the fuselage to house the load, and since loaded cargo compartments average four to five times the density of loaded passenger compartments, choice of minimum passenger-cargo ratio would achieve maximum payload.

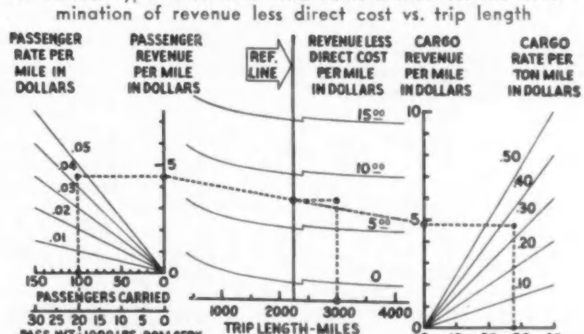
The second prerequisite, passenger comfort, involves financial considerations such as rate structure, revenue earning ability, payload, and operating cost of the airplane. In competitive operations, other things being equal, the airline offering the most in passenger comfort and service for a given fare, Mr. Rummel noted, will attract the most customers. This consideration comes into prominence during periods when available capacity in seat miles exceeds the passenger revenue miles flown. Present trend is toward higher standards of luxury despite payload penalties involved, since a small increase in payload carried will more than offset the disadvantage of higher empty weight.

Preparation and analysis of generalized data can be of assistance in illustrating the resulting economic effects of such items as the selection of various comfort standards, passenger-cargo ratios, payloads, and rates. Economic aspects so determined may then be weighed with other pertinent factors.

Graphical representation of such data, shown in Fig. 1, illustrates a means for conveniently determining the effect of various passenger and cargo capacities and ratios, or any combination of these factors, upon the revenue and direct operating cost per mile for any trip length within the range of a specific airplane. In preparation of this chart, Mr. Rummel pointed out, it is necessary to consult payload range data to make certain that the combined passenger and cargo weight does not exceed the payload capacity of the airplane for the trip length being considered. The curves themselves are not perfectly accurate and require adjustment if strict accuracy is desired.

In conclusion, he advises, it is most desirable to consider the economic results of operation of the most promising arrangements on a fleet basis before reaching final decisions. While the percentage return on the investment is a tempting overall criterion, results forecast on this basis must be weighed heavily against the competitive and traffic generating capabilities of the airplane. It is not difficult to show an increased payload on paper by stripping the plane of all luxury items. This path must be tread cautiously, however, for, if in the quest for lower fares, the preference for flying over other means of travel is not instilled in the average passenger, the air transport industry will have defeated its own purpose – mass public acceptance of air travel.

Fig. 1 – Representation of economic factors in the selection of airliner type of service. This chart is used for the determination of revenue less direct cost vs. trip length



Automobile Designers Tackle New Problems

Digest of talk

by CHARLES A. CHAYNE
Buick Division, General Motors Corp.

■ Western Michigan, Jan. 29

(Summary of ideas expressed by Mr. Chayne in his talk on "Current Automobile Problems")

THE public is accustomed to the three-passenger front seat with good leg room, Mr. Chayne pointed out; thus, the rear engine car, to maintain this room for comfort, would have to be 12 in. longer than present cars. This would create a definite problem, since most garages are now just adequate. He added that the front seat is confined to its present location by front wheels, and that the crosswise engine is not the solution for more space. A further reason for necessarily longer design in rear engine cars would be the necessity of moving the rear wheels back to maintain equal weight distribution. Front wheel drive is not, he said, the answer, for it results in steering limitations.

Changes in the powerplant, he believes, will not be rapid, but will keep pace with fuel changes and with the demands of competition. Modern low grills make air-cooling inapplicable to the present car.

Refinement is possible on the chassis, he said, but the torsion bar is not the answer, for it is not economical as regards weight and cost. Great improvements are due in clutch and transmission.

Discussion

In the informal question and answer period after Mr. Chayne's talk, the following points were brought out:

Q. Can weight per hp be reduced in present engines?

A. Yes, it should decrease as the cost of light alloys falls.

Q. Will crankshaft speed increase?

A. Not above 5000 rpm, in the speaker's opinion; however, as the compression ratio is raised to take advantage of high octane fuel, engine speed will increase. Higher engine speed is advantageous in that the size of the torque converter can be kept down.

Q. Is anything being done to pick up hp in pumping losses?

A. Separate manifolding to each cylinder would help; supercharging has possibilities, but is too expensive.

Q. What are your opinions on water injection and sealed cooling systems?

A. Water injection may have a place with supercharging, but there is no advantage at atmospheric pressure.

Q. Is anything being done to rustproof water jackets?

A. Water jackets could be permanently rustproofed at factory, but there is no public demand for it.

Q. Will aircraft experiences be passed on to the automotive industries?

A. Only in so far as production methods are concerned.

Q. Why are cars being made heavier?

A. To satisfy the public demand for leg room, comfort and power.

Q. Is anything being done to make use of plastics?

A. Not much; plastics still present problems of damage repair.

Q. Will the tendency be to return to 6-cyl engines?

A. The eight will probably remain because of the advantages of the small combustion chamber.

Q. Will plastics be used for upholstery and trim?

A. Probably. However, plastics must be made less fibrous so that they will not crack in sewing and will wear better.

Q. Will there be improvements in headlighting to eliminate glare?

A. Polaroid lenses are possible, but at present impose a prohibitively high electrical load.

Q. What determines engine life?

A. Bearings, rings, and oil are the chief limiting factors on engine durability and life.

Q. What improvements are being made on mufflers?

A. Aluminum-covered steel will soon appear in mufflers.

Q. Will air conditioning be a feature of future cars?

A. Not in the speaker's opinion, because equipment is too costly and not dependable.

Importance Plus Difficulties Makes Valve Testing Intricate

Digest of paper

by VINCENT AYRES
Eaton Mfg. Co.

■ Twin City, Dec. 6

(Paper entitled "Valves and Valve Testing")

VALVES are classified according to the function for which they are designed; simple automotive valves for passenger cars comprise one group; valves for medium and heavy-duty truck applications form the second; very heavy duty, high output engine valves used mainly for trucks make up the third, and high-output aircraft valves the fourth. Since better materials are used in each successive classification, cost jumps, and designers attempt to stay in the lowest cost group possible. The second group, Mr. Ayres reported, may give longer service than the first; the third group is sodium-cooled, and allows some gain over noncooled valves; and aircraft valves are of basic austenitic steel, for high hot strength, good forging properties, and good nitriding properties for stem wear resistance.

The value of sodium as a cooling agent is derived from its fluid nature at low temperatures (207 F), stability at high temperatures, low vapor pressure, fairly good heat conduction, good wetting of steel surfaces, lightness, lack of corrosive effect on valve steel when clean, and easy handling in manufacture.

Valve Testing

The difficulties encountered in seeking causes of valve failure are amplified, the author explained, by the fact that when failed valves are returned, clues usually have disappeared . . . the engine may have been rebuilt and put back into service. At the same time, there are so many minor details which may contribute to failure that determination of the actual cause is often impossible.

The basic importance of valves, and the many things which may go wrong, make valve testing an intricate and vital process. Valves which have been used and refaced must be checked to insure that they are within normal limits on valve stem wear, seat runout, tip wear, stem scuffing, margin thickness, and so on. Guides must be checked for stem to guide clearance, block seat runout must be low, not chattered, and valve spring load must be proper.

Important causes of valve failure, he explained, are improper lash and camshaft design; tool marks on valve stems caused by the grinding wheel in regrinding the valve seat; poor retainer keys which wear and gouge the stem; excessive heat caused by improper setting of the distributor or lack of cooling in the engine.

Sticking valves may be remedied by lowering temperature at the point where the valve enters the guide – by either moving this point further down the stem by counterboring, cutting off guides, providing better cooling around the guide boss, cooling the valve with more oil, or lowering the valve temperature through better valve seating.

Normal methods of developing valves, he reported, are to repeat failure conditions of engines in service on the dynamometer, or to set up controlled test procedure on an engine which will give a similar failure in a shorter time. An attempt is made to control variables of valve seating, valve temperature, and fuel. Mixture distribution in the engine, however, is not controlled, since this apparently determines why valves in different cylinders appear to have varying operating temperatures. Everything is done purposely, he said, that manufacturers are advised not to do, so that valve burning, lead corrosion, and dishing may all be produced in the same test.

Newly designed testing methods . . . electrical means have proved most successful . . . make it possible to determine from oscillograph records which aspect of valve design must be investigated to improve motion.

Important adjuncts to corrective testing, Mr. Ayres pointed out, are automatic valve gear studies to predetermine troubles which may arise in a new design while there is still time for making changes.

Evolving Passenger Car Design

Reflects Engineering and Public Opinion

Digest of paper

by A. G. HERRESHOFF

Chrysler Corp.

■ Detroit, March 25

(*Paper entitled, "The Future Cars – Evolution or Revolution"*)

PREDICTION of future automobile design and construction trends can best be made by an analysis of the motivating forces behind the progressive development of the automobile since its inception, Mr. Herreshoff stated.

Rationally following through the development of major design changes by presenting a number of illustrative cases, he provided a logical basis for projection into the automobile future.

For example, he pointed out, passenger space on the present-day car has grown to take up most of the space on the vehicle and, in contrast to early automobile models, the powerplant and other mechanical parts are tucked away in a space no larger than the luggage compartment. Because of the passenger arrangement, installation of the powerplant in the front is necessary to bring the center of weight to the proper location. A rear engine or no engine would impose too much weight on the rear wheels.

If present tendencies continue, he observed after reviewing the automobile's historical background, cars will have more automatic gadgets, greater length, and greater weight which will compel development of more powerful engines. This can be done, but at the price of complicating the entire car and increasing its cost.

The present improvements are the results of refinements of the original, basic elements such as better heat treatments and better fuels which have resulted in more power per pound of weight, longer life, more comfort, and greater sales appeal. However, it is interesting to note that this period of accelerated development has not brought forth or exploited any new materials, inventions, new fuels, or radical chemical reactions.

Many unforeseen factors may guide or change future development, for example: change in national economy, or invention of superior powerplants, fuels, and materials. Improvement of our highway system or more general use of air transportation can so change public demand that a very different automobile may result.

Judging from the past, Mr. Herreshoff concluded, the evolution of the automobile will result from improved engineering, developments in strength of existing materials, more power from improvements of present fuels, more comfort through intensive engineering studies, and perfection of safer and more controllable cars running at faster speeds over better roads, on a scale permitting a price low enough for mass marketing.

Excerpts from paper

by HOWARD A. DARRIN

Kaiser-Frazer Corp.

■ Detroit, March 25

(*Paper entitled, "Does Styling Control the Design of Cars?"*)

STYLING is a controlling factor in car design and is of importance in the same ratio as the wind tunnel is to the design of the airplane.

There have been articles in the press as to what the public will not get and it is hoped that this is not an indication that the industry will return to the prewar policy of having a new design every year which consists of a different type of chrome plumbing in ever increasing quantities without the benefit of hot and cold running water. It is believed that the customers would prefer something useful rather than doubtfully decorative.

To pooh-pooh the curved windshield, automatic jack, use of plastics, full view vision, and many other innovations demanded by the public is sticking out your neck. What the public demands it will get, and not in the distant future. There are companies already preparing production models embodying many of these improvements mentioned.

There are several cases where styling has definitely improved the comfort and the practicality of the automobile. It was assumed that the original intention for widening the body of the Packard Clipper was to give more room and not for styling reasons. This was not the case. The styling of the continuous fender treatment coming through the door at the "A" pillar made it necessary to widen the inside of the body to permit the proper hinging of the door, the net result being a wider and more roomy car. This is also the case with the Kaiser-Frazer in which the blending of the front and rear fender permits at least six additional inches inside the body without increasing the tread.

The Packard custom bodies built in semi-production are also a good example of where styling is an indirect cause of improved body conditions. This car was designed with a very long hood to give it a racy appearance which inadvertently brought the steering wheel closer to the windshield. The result was that the windshield pillar was farther back than on any other car in relation to the driver and the visibility was greatly improved thereby.

Styling has certain definite limitations. For instance, a windshield cannot be placed on the very front end of a car as there is a limit to its forward position because it has been definitely proved that visibility is hampered if the windshield is not a normal distance from the driver's eyes.

Design of the Kaiser-Frazer cars presented a difficult problem. Although it was known by the designer that management might change its mind, he was told to allow for the motor in the rear, which meant that the whole passenger compartment had to be moved forward. The shift put the "A" pillar five inches farther forward than any of the contemporary cars. In the event of the motor being placed in front, something radical would have to be done in styling to accommodate the motor and radiator. It was also feared that a stubbiness in front would be criticized by the buying public. As the overall length was frozen, the problem was to style the car in such a way as to give the bonnet and the fenders the longest appearance possible. The designer accomplished this feat by curving the silhouette forward and then down to come flush with the edge of the bumper. In spite of the advanced passenger compartment, no room was wasted when the management decided to move the motor to the front because the space was used for an extremely large baggage compartment. The designer was still able to widen the rear seat which was placed ahead of the wheel house.

Another example where styling helped construction is the sloping windshield as it increased visibility and reduced the size of the turret. The "V" windshield, another styling feature, strengthened the turret top construction by giving a creased line in the front center of the roof. The torpedo type fender extending over the rear permitted a larger baggage and passenger compartment and the same type fender extended over the front of the car permitted the motor and radiator to be advanced considerably giving additional space inside the body.

For many years door hinges were left protruding from the side of the body. The customer finally forced the body engineer to design a concealed hinge which not only enhanced the beauty of the body, but was a better and cleaner mechanism. Door handles came under the same category. Before the war, one of the leading companies designed a door handle that was flush with the body sides. Unfortunately, this device was apt to freeze in cold weather and some women complained of breaking their nails. However, these difficulties can be overcome and we should see flush door handles on many cars next year.

Radiator caps have been on the exterior for many years and it has been a slow process of elimination. A good many years ago the Chalmers Motor Car Co. attempted to take off the radiator cap on one of their models, but the public, being in the habit of seeing this cap on all previous cars, made it necessary to build a false cap although the radiator was filled from the inside of the bonnet. This is an example of the public's reluctance to accept anything that their eyes are not used to and changes like this must necessarily be gradual as is proved by the length of time it has taken to finally eliminate the radiator cap or ornament completely.

Changes must be made gradually, but in a hurry. But before all, progress should be made. The ten million dollar proving grounds should be used and really made improving grounds. There should be cooperation with the heads of styling and color departments to encourage new creations that are practical so that they can back up their department designs with the practical knowledge necessary to convince the body and chassis engineers that their dream cars are feasible.

See Car Ride Improved By Hydraulic Transmission

Digest of paper

by A. H. DEIMEL
Spicer Mfg. Co.

■ Annual Meeting, Jan. 9

(*Paper entitled "Hydraulic Transmission Performance"*)

EXPERIENCE with the smooth and rapid starting and quick acceleration of hydraulic transmissions in heavy duty vehicles indicates that the same features would be desirable in a passenger car transmission. Hydraulic transmission can materially enhance various types of operations, Mr. Deimel declared, provided the system is designed for the type of service the vehicle is to encounter.

Torque converter design has been considerably advanced in the past 12 years, he demonstrated by comparing a 1933 European model, the Leyland HTC3, with the new Spicer 916. In the interests of good performance and economy, the converter should hold the engine to low speeds at starting and should then let the engine accelerate with the vehicle. Indicative of a torque converter's ability to perform this function is its maximum torque capacity.

Analysis reveals that the American converter has two and one-half times the torque capacity of the Leyland model. In addition, the Spicer unit has a greater torque multiplication than has the European torque converter. Although maximum torque multiplication in a hydrokinetic unit may be increased at a sacrifice in range, performance in the vehicle demonstrates a wide range for the Spicer 916.

Another feature characteristic of postwar hydraulic transmissions is improved fuel economy. With the new design, the vehicle starts almost immediately on opening the throttle. This is the result of the high torque multiplication and also the high torque capacity of the units, as the engine does not have to rise much in speed to produce output torque sufficient to overcome rolling resistance. This feature makes for faster getaways and increased fuel economy as fuel is not wasted in accelerating.

A chart produced with a recording accelerometer indicates the smoothness and high value of acceleration obtainable with the 916 hydraulic transmission.

Consideration should be given to the actual operation of the vehicle in choosing desirable characteristics for a transmission, Mr. Deimel advised. Attempts in the past to produce a satisfactory reaction coupling to perform the functions of both a torque converter and a coupling have been unsuccessful. If the blading is designed as a converter to give torque multiplication, then performance as a coupling will be unsatisfactory as the coupling operation will involve too much slip. This becomes more apparent when it is realized that a torque converter can be designed with its peak performance as any desired speed ratio; whereas a coupling must be designed with its peak performance as close as possible to the 1:1 ratio.

For good performance, the torque converter should be designed to give peak performance at the best average ratio for the service. Following this principle has proved successful by the results obtained in fuel economy. Careful tests have shown that in multistop service, equal economy is obtained for the same scheduled speed as with a mechanical three-speed gear box.

Engines for vehicle drives have in the past been subject to the limitations of transmissions. For example, high torque at low engine speeds is required with a gear box to permit hanging on to a high gear ratio at low speeds. This is not required with a hydraulic drive and the engine can be designed to produce its torque at higher speeds.

Turbocharging Boosts Diesel Efficiency 50%

Digest of paper

by C. F. HARMS
Elliott Co.

■ Dayton, Nov. 19

(*Paper entitled "Turbocharger Design and Application"*)

TURBOCHARGING can increase the output of a 4-cycle diesel engine by 50%, Mr. Harms observed. To obtain these high efficiencies, careful consideration must be given to both application of the turbocharger to the engine and to the engine design itself.

Important details in the design of a turbocharged engine are the valve areas, cylinder head and piston head crown contour, valve timing with corresponding design of the cam shaft, injection nozzles, and manifold contoured area. The Elliott-Buchi turbocharger described has been applied to four-cycle diesels for marine, stationary, and rail applications in sizes up to 2000 hp and speeds up to 1200 rpm. This turbocharging system utilizes the initial high pressure of the gas leaving each cylinder at the beginning of the exhaust stroke by the proper proportioning of exhaust manifolds and turbine nozzles. The energy obtained is used to drive the turbine.

To prevent interference between the gas impulses and blowing out of exhaust air from other cylinders during the scavenging period of a given cylinder, separate manifolds are conducted to banks of the nozzle in the turbine. Scavenging both clears the clearance space in the cylinder of exhaust gases and replaces them with clean, cool, fresh air under pressure. Scavenging and pressure charging combined permit combustion of a greater quantity of fuel without harmful effects on the engine, and consequently a higher output than with unsupercharged engines of the same displacement.

Construction of the exhaust manifold permits the transmission of a series of pressure waves to the turbine. Multiple manifolds eliminate the interference between the exhaust of one cylinder and the next one to fire. This leaves the cylinder space with a descending piston at a continually decreasing pressure. When the cylinder pressure is about the same as the intake manifold pressure, the inlet valve is opened allowing complete scavenging.

Numerous corrections must be made to performance results of this system, Mr. Harms emphasized, due to the pulsating flow. Not only is performance influenced by the pulsating pressure, but the actual design of the turbine is somewhat warped from conventional design to best utilize the energy available in pressure flow pulsations. The turbine wheel diameter and speed are selected to give a value of greater than 0.50 for the ratio of turbine bucket velocity to theoretical gas velocity – the characteristic criterion in turbine efficiency determination. This is higher than the value chosen for impulse type turbine design.

Another factor in turbocharger turbine design is the amount of reaction which will give best results. A straight reaction single-stage turbine is generally most efficient for this type of service since the energy available is relatively low because of the low exhaust pressure ahead of the turbine.

To properly produce a successful turbocharger, it is necessary to develop metals capable of withstanding speeds of 21,000 rpm, for an 11-in. diameter wheel at temperatures in excess of 1000 F. Found satisfactory was a stabilized austenitic stainless steel containing such metals as chromium, molybdenum, tungsten, titanium, and manganese. This alloy is quite ductile and very difficult to machine.

Fuel economies of 25% have been shown at ¼ load operating conditions of turbocharged engines. Whereas a normally good and well designed engine can be turbocharged to approximately 50% increase in output, there have been cases of 60%, 70%, and even higher increases. Mr. Harms felt that these high outputs were not solely a function of the turbocharger, but were due in part to complete and thorough engineering and modernization of the engine to be turbocharged.

Modern Foundry Practice Betters Economy, Quality

Digest of talk

by L. B. THOMAS
Wilson Foundry and Machine Co.

■ Western Michigan, Feb. 21

(*Summary of ideas expressed by Mr. Thomas in his talk on "Foundry Modernization"*)

MODERNIZATION in the foundry, Mr. Thomas said, means mechanization. It should start in the back yard with neat piles of graded pigs. Pigs were formerly graded entirely on the basis of grain structure in the fracture, he reported, with the finest grained iron graded as No. 1; however, this system has been outmoded by present-day careful chemical analysis of each car of iron.

Cupola operation has improved, he said, with controlled air blast temperature and moisture content. To show why controlled air is necessary, he reported that 600,000 cu ft of air per hr pass through Wilson's cupolas to melt 20 tons of iron. A change in air temperature and moisture content would seriously affect the iron quality, especially since ordinary atmospheric moisture varies

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	Willey, A. O.	Low Speed, High Torque Testing of Gear Lubricants for Hyphoid Axles	June 2-7, 46
	Wolf, Austin M.	German Automotive Developments (Chassis Developments in the German Automotive Industry)	June 2-7, 46
	Zwahl, C. E.	High Speed Testing of Gear Lubricants for Hyphoid Axles	June 2-7, 46

Papers Previously Announced

Vehicles

Check Here	Author	Title of Preprint of Paper	Date of Presentation
	Aldag, R., Jr.	Diesel Electric Locomotive Operation	Oct. 9, 45
	Ayres, Vincent	Valves and Valve Testing	Dec. 6, 45
	Austen, Robert N.	Maintenance Engineering of Chassis Leaf Springs	May 9, 45
	Belsky, J. D.	Development of a Diesel Maintenance-Training Program	May 21, 46
	Brunken, Renke	White Hydro Torque Drive	Jan. 7-11, 46
	Bryan, H. F.	Combustion in a Pre-Combustion Type Diesel Engine	Jan. 7-11, 46
	Burkhalter, R. R.	German Automotive Transmission Systems Development & Design	March 4, 46
	Cass, Robert	Motor Trucks of the Future	Jan. 7-11, 46
	Corey, Lt.-Col. C. H.	Technical Investigation of German Automotive Materiel	March 4, 46

Vehicles—Continued

Check Here	Author	Title of Preprint of Paper	Date of Presentation
	Church'll, H. E. Delp, M. Z. Hykes, P. G.	Fundamental of Suspensions	Jan. 7-11, 46
	Colwell, A. T.	Alcohol-Water Injection	Jan. 8-12, 45
	Colwell, A. T.	Fuel Requirements for Farm Tractors	Sept. 13, 44
	Davies, R. H.	Design of German Hydraulic Systems and their Components	Jan. 7-11, 46
	Deimel, A. H.	Performance of Hydraulic Transmissions	Jan. 7-11, 46
	Fairbank, H. S.	Highways of the Future	Jan. 7-11, 46
	Franzen, Tore	Suspension & Track of German Military Track Laying Vehicles	March 4, 46
	Gerler, Capt. W. C.	The German Jumo 004 Engine	Jan. 7-11, 46
	Hammond, C. F.	Steering as Affected by Suspension	Jan. 7-11, 46
	Harms, Carl F.	Turbosupercharger Design and Application	Nov. 19, 45
	Hawthorne, W. R.	Some Factors Affecting the Design of Jet Turbines	Jan. 7-11, 46
	Heldt, P. M.	Transmissions Giving Uninterrupted Acceleration	Feb. 13, 46
	Heron, S. D.	Fuel Sensitivity & Engine Severity in Aircraft Engines	April 3-5, 46
	Heussner, C. E. Johnson, E. T.	Substitutes for Tin in Automotive Vehicles	Jan. 7-11, 46
	James, W. S.	The Perfect Automatic Transmission	Jan. 7-11, 46
	Landen, E. W.	Combustion Studies of the Diesel Engine	Jan. 7-11, 46
	Laurie, G. W. Taussig, W. A. Willett, H. L., Jr. Wilson, D. K.	Symposium – Approaches to Vehicle Retirement	Jan. 7-11, 46
	Loweke, E. F.	Power Brake Valves	Nov. 1, 45
	McCain, G. L.	Engineering of Involute Splines	Jan. 7-11, 46
	Miller, R. J.	Torque Converters	Jan. 7-11, 46
	Mock, F. C	Engineering Development of the Jet Engine and Gas Turbine Burner	Jan. 7-11, 46
	O'Conner, B. E.	Damping in Suspensions	Jan. 7-11, 46
	Palsulich, J. Blair, R. W.	Testing of Highly Loaded Sleeve Bearings	April 3-5, 46
	Price, N. C.	Mechanical Design Considerations Influencing Blading Performance in Aircraft Gas Turbine Power Plants	Jan. 7-11, 46
	Quartullo, O. F.	The Driver's Comfort	Jan. 7-11, 46
	Sanders, Ray	Cleaning Symposium – How Chemistry Simplifies Automotive Cleaning Methods and Procedures	Jan. 7-11, 46
	Schilling, Robert	Flexible or Spring Medium of Suspensions	Jan. 7-11, 46
	Shoemaker, F. G. Gadebusch, H. M.	Effect of Fuel Properties on Diesel Engine Performance	Jan. 7-11, 46
	Sinclair, J. W.	How to Drive a Truck	Oct. 26, 45
	Smith, L. H.	Motor Coaches of the Future	Jan. 7-11, 46
	Stewart, Hugh B.	An Electrical Model for the Investigation of Crankshaft Torsional Vibrations in an In-line Engine	Nov. 1, 45
	Stout, W. B.	What Motor Cars Could Be	Jan. 7-11, 46
	Super, R. K.	Review of Brake Design and Methods of Rating Brakes for Commercial Automotive Vehicles	Jan. 7-11, 46
	Taub, Alex	The Relationship of Lines vs. Shape on Miles per Gallon	June 2-7, 46
	Taylor, C. Fayette	Effects of Engine Exhaust Pressure on the Performance of Compressor Turbine Units	Oct. 4, 45
	Thorne, M. A.	German Army Vehicle Engines	March 4, 46
	Twyman, L. R.	Hydraulics as Applied to Tractors and Farm Machinery	Sept. 13, 45
	Watson, R. A.	Bearing Developments Resulting from Restrictions of Materials	Sept. 15, 45
	Weider, R. L.	Observations of Various German Suspensions and Steering Gears	March 4, 46
	Wheeler, J. W.	German Autobahn – Its Relation to German Industrial Economy & Traffic System Used	March 4, 46
	Young, F. M.	German Radiators & Oil Cooler Structures and Facilities for Manufacture	March 4, 46

Aeronautics

Check Here	Author	Title of Preprint of Paper	Date of Presentation
	Ailor, Howard	Personal Flying	Oct. 10, 45
	Benedict, M. C.	Aviation Gas Turbine Installation Problems	Oct. 4, 45
	Berry, B. M. Rollins, F. S.	Aviation Lubricating Oils	Aug. 24, 45
	Brandt, C. S. Wold, W. C.	Some Aspects of Under-Wing or Pressure Refueling	Oct. 4, 45
	Canney, F. R.	Provisions for Overwater Operation	Dec. 3-5, 45
	Chase, Capt. J. H.	Control Decks for Long Range Aircraft	Dec. 3-5, 45
	Christenson, C. M.	A Report on the Nature of Ice Formation on Aircraft as Related to Airline Operations	Nov. 1, 45
	Clyman, H. J.	Jet Propulsion & Gas Turbines in Aviation	Dec. 12, 45
	Crawford, M. B.	The Air Lines Air Cargo Problems	Dec. 3-5, 45
	Cutrell, Lt. Col. E. A.	All-Weather Flying Facilities	Jan. 7-11, 46
	DeHaven, J. C.	The Development of Magnesium Alloys as Aircraft Materials	April 3-5, 46
	Doman, Carl T.	General Requirements for Helicopter Engines	Nov. 1, 45
	Draney, J. J.	Heat Recovery as Applied to the Heating and Anti-icing of Aircraft	Jan. 7-11, 46
	Eaton, D. C.	Cruising Economy By Use of Water Injection	Nov. 1, 45
	Edwards, H. K.	Psychological Requirements for Aircraft Passenger Design	Dec. 3-5, 45
	Gill, John	All-Weather Flying Techniques	Jan. 7-11, 46
	Godsey, F. W., Jr.	Gas Turbine & Aircraft	Oct. 4, 45
	Gulbransen, H. E. Capt.	Transoceanic Air Navigation	Dec. 3-5, 45
	Hall, R. S.	Aircraft Gas Turbines with Centrifugal Compressors	April 3-5, 46
	Hammen, T. F., Jr. Rowley, W. H.	Factors Pertaining to the Installation of Inverted, In-Line Air-Cooled Engines	Nov. 1, 45
	Hanley, W. V. Hundere, A.	Economics of Airline Fuel Utilization	Nov. 1, 45
	Haver, R. L. Goodin, H. A., Jr.	Design Trends in Aircraft Exhaust Systems	Jan. 7-11, 46
	Heino, A. F.	Airport Terminal Design	Dec. 3-5, 45
	Johnson, S., Jr.	Air Fixtures and Air Controls	Jan. 7-11, 46
	Jones, Alun R.	Airplane Icing Problems and Its Alleviation through Research	Nov. 1, 45
	Judd, F. V. H.	A Systematic Approach to the Aerodynamic Design of Radial Engine Installations	April 3-5, 46
	Kelly, R. D.	Review of Air Transport Developments in America	Jan. 7-11, 46
	King, W. J.	Axial versus Centrifugal Superchargers for Aircraft Engines	May 7, 45
	Kirchner, O. E.	Foreign Observations	Jan. 7-11, 46
	Knight, J. E. Baxley, C. H.	Modern Aircraft Refueling	Oct. 4, 45
	Landgraf, F.	Helicopter Design Problems	Nov. 1, 45
	Long, D. W. Lt. Col.	Air Transport Command Cargo Loading Experience	Dec. 3-5, 45
	Manildi, J. F.	The Theory of Operation and Field of Application of the Turbo-jet, Ram-jet and Pulse-jet	April 19, 46
	Martinez, Karl Schnitzer, S. Berry, M. M. DeCourcey, D.	Auxiliary Power Systems for Aircraft	June 7, 45
	Messinger, B. L.	Refrigeration for Air Conditioning Pressurized Transport Aircraft	Dec. 3-5, 45
	Monroe, K. C.	Research & Development of Aircraft Accumulators	Nov. 1, 45
	Payne, A. O.	Fueling a Half Forgotten Bit of Aircraft Design	Oct. 4, 45
	Pigott, R. J. S.	Analysis of Positive Supercharger Losses	Nov. 14, 45
	Ray, James G.	Some Requirements of a "Feeder" Airplane	April 3-5, 46
	Rowe, M. R. Ladd, G. T.	Water Injection for Aircraft Engines	Aug. 24, 45
	Rugge, R. A.	Fluorescent Lighting for Commercial Airplane Interiors	Dec. 3-5, 45
	Rummel, R. W.	Aircraft Interiors from the Airline Viewpoint	Dec. 3-5, 45
	Saint, S. P.	A System Specification for Air Navigation and Traffic Control Development	Dec. 3-5,'45
	Schairer, G. S.	Some Effects of Payload vs. Range Characteristics on Transport Aircraft Efficiency	Feb. 12, 46
	Schweitzer, P. H. Sharples, L. P.	S-S System of Lubrication for Aircraft Engines	Oct. 4, 45
	Short, Mac	An Aircraft Approach to Automobile Body Design	Jan. 7-11,'46
	Sweeney, W. J. Kunc, J. F., Jr. Morris, W. E.	Aircraft Engine Induction System Deposits	Jan. 7-11, 46
	Vanik, M. F.	Flight Engineer Station Design and Requirements	Dec. 3-5, 45
	Weeks, W. L.	Factors in Aeration and Deaeration of Aircraft Engine Oil	Oct. 4, 45
	Wendell, E. E. Warden, H. H. Kerr, H. H.	Weight Reduction in Aircraft Braking System thru the Use of Reverse Thrust Propellers	Oct. 4, 45

Fuels and Lubricants

Check Here	Author	Title of Preprint of Paper	Date of Presentation
	Adams, E. W.	Performance Testing of Wheel-Bearing Lubricants	Nov. 6-7, 45
	Ainsley, W. G. Strehlow, W. F.	Effect of Octane Number & Volatility of Tractor Fuels on Horsepower and Fuel Economy of Tractor Engines	Feb. 12, 46
	Alspaugh, M. L.	Gasoline Gum Tolerance of Ordnance Equipment (Report of CFR Committee)	Jan. 7-11, 46
		Symposium on Fuels and Lubricants	
	Best, H. W. Ainsley, W. G. Keyser, P. V. Sabina, J. R. Jeffrey, Lt.-Col. R. E.	Significance of Octane Number Progress Report on Grease Projects Improved Gear Lubricants Stable Gasoline for War and Peace Heavy Duty Oils in Military Service	Jan. 17, 46

Fuels and Lubricants—Continued

Check Here	Author	Title of Preprint of Paper	Date of Presentation
____	Brooks, D. B.	A Review of the Development of Reference Fuel Scales for Knock Rating	Jan. 7-11, 46
____	Cattaneo, A. G.; Bollo, F. G.; Stanly, A. L.	A Petroleum Research Engineer's Outlook on Fuels for Conventionally Powered and Gas Turbine Aircraft	Aug. 24, 45
____	Griep, Com. E. F.; Goddin, Lt. Com. C. S.	Significance of Cetane Number in Fuels	Nov. 6-7, 45
____	Holaday, W. M.	Wartime Refinery Operations and Their Effect upon Future Motor and Aviation Fuels	Feb. 1, 46
____	Kauppi, T. A.; Pedersen, W. W.	Silicones as Lubricants	Nov. 6-7, 45
____	Klein, Maj. N. L.	German Military Fuels and Lubricants	March 4, 46
____	Kratzer, J. C.; Green, D. H.; Williams, D. B.	New Synthetic Lubricants	Jan. 7-11, 46
____	Larson, M.	Diesel Fuel Additives Create New Concepts	Nov. 6-7, 45
____	Tongberg, C. O.; Ellis, R. E.; Baxley, C. H.	Application of Heavy Duty Additives to Aviation Oils	Nov. 6-7, 45
____	Veal, C. B.	Philosophy of Cooperative Research	Jan. 7-11, 46
____	Wolf, H. R.	Motor Oils – Regular, Premium and Heavy Duty	Jan. 7-11, 46

Miscellaneous

Check Here	Author	Title of Preprint of Paper	Date of Presentation
____	Collyer, John	Outlook for Rubber for the Automotive Industry – Synthetic and Natural	Jan. 7-11, 45
____	Dunning, Dr. J. R.	Development of Atomic Energy	Jan. 7-11, 46
____	Glen, Earl W.	Observations of the German Rubber Industry	March 4, 46
____	Grunder, Maj. L. J.	War Developments of the Oil Industry in Austria and Roumania	March 4, 46
____	Martz, L. S.; Peden, W. T.	Latest Developments in Honing Techniques	Jan. 7-11, 46
____	McBrearty, J. F.	Utilization of New High Strength Aluminum Alloys	Oct. 4, 45
____	McCloud, J. L.	Methods of Specifying Materials	Jan. 7-11, 46
____	McEwen, Lt.-Col. E.	Highlights of German Tank Transmission Design & Development	March 4, 46
____	Miller, Roy A.; Tatman, Max E.	Shop Aspects of the New High Strength Aluminum Alloys	Oct. 4, 45
____	Porter, F. P.	Methods for Calculating Torsional Vibration	Jan. 8-12, 45

		Members	Non-Members
——SP-1.	Drafting Room Practice (C. A. Gladman)	.25	$1.00
——SP-2.	Engine Deposits: Prevention and Removal	.25	1.00
——SP-3.	For the Sake of Argument	.50	1.00
——SP-5.	Evaluation of Effects of Torsional Vibration	5.00	10.00
——SP-7.	Leaf Spring Manual	1.00	2.00
——SP-8.	Aluminum Castings Procedure	1.00	2.50
——SP-9.	Helical & Spiral Spring Manual	.50	1.00
——SP-11.	Volute Spring Manual	1.00	2.00
——SP-11A.	Supplement to Volute Spring Manual	1.50	3.00
——SP-18.	Reclamation of Engine Valves	.50	1.00
——SP-20.	Foundry Process Control Procedures (Ferrous)	1.50	3.00
——SP-21.	Fungi Prevention For Automotive Electrical Equipment (Milit'y)	.25	.50

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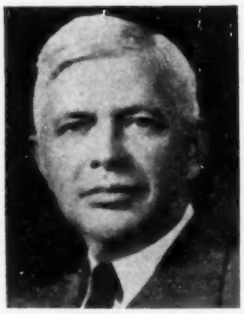
General Motors Corp. Modifies Top Structure

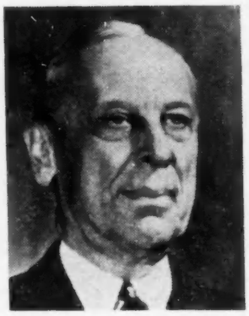
CHIEF EXECUTIVE



C. E. Wilson

President **C. E. WILSON** was designated as the chief executive officer of the corporation, and becomes chairman of the Operations Policy Committee. **ALFRED P. SLOAN, JR.**, remains as board chairman. **L. C. GOAD** was elected a director and named to this top committee, together with executive vice-president **O. E. HUNT** and **T. P. ARCHER.**

BOARD CHAIRMAN



Alfred P. Sloan, Jr.

SAE Members on 9-Man Operations Policy Committee, GM Top Group, Under Chairmanship of C. E. Wilson

T. P. Archer

L. C. Goad

O. E. Hunt

New General Managers of Divisions

HEADS CHEVROLET

NICHOLAS DREYSTADT was appointed by Mr. Wilson general manager of the Chevrolet Motor Division, and **JOHN F. GORDON,** formerly chief engineer of Cadillac Motor Car Division, becomes general manager.

Nicholas Dreystadt

HEADS CADILLAC

John F. Gordon

RALPH E. WALSH, formerly an engineer with Breeze Corporations, Inc., Newark, N. J., has joined the engineering research department of the Celanese Corp. of America, Plastics Division, Newark, N. J. His duties will be to design and develop machinery for the Plastics Division.

Previously associated with the Wegner Canning Corp. of Eustis, Fla., **GEORGE V. DICKERSON** has become chief inspector, aircraft department, Pratt & Whitney Aircraft, division of United Aircraft Corp., East Hartford, Conn.

Formerly director of research, Ingersoll-Rand Co., Phillipsburg, N. J., **FRANK B. DOYLE** is now affiliated with the Baldwin-Hill Co. of Trenton, N. J.

R. E. S. DEICHLER has been appointed vice-president of sales of American Airlines, Inc., to succeed **CHARLES A. RHEINSTROM,** who has resigned as a vice-president and director of the company. Formerly vice-president of administration, Mr. Deichler joined American Airlines in August, 1945.

J. R. GUSTAFSON has recently joined the Research and Development Division, Ford Motor Co., automotive research department, Dearborn, Mich. Mr. Gustafson, who is an active member of the Spring Committee and the Iron & Steel Committee of the SAE Technical Board, was formerly associated with the Muehlhausen Spring Corp. of Logansport, Ind., as chief engineer.

HAROLD D. HOEKSTRA has been appointed chief engineer of the Aircraft & Components Service, Civil Aeronautics Administration, according to an announcement made by **T. P. WRIGHT,** administrator of Civil Aeronautics. He has been the CAA's representative on the SAE Aircraft Materials & Processes Committee since it was organized. His new duties will prevent his continuing this assignment, which has been given to Burdell L. Springer, chief of the CAA Materials & Processes Section.

RICHARD CRETER, Metropolitan Section's vice-chairman for Diesel Engineering, has been appointed field engineer of Rogers Diesel & Aircraft Corp., New York. He had been the company's service manager.

J. I. HAMILTON was recently appointed assistant sales manager of Curtiss Propeller Division, Curtiss-Wright Corp., Caldwell, N. J. He served Metropolitan Section as Chairman of its Membership Committee during the past year.

ROBERT G. HOOF, sales engineer for the Pacific Division of Bendix Aviation Corp., has been put in charge of the company's postwar electrical sales program and will be assisted by **WILLIAM P. HARRISON,** until recently a representative of the division in St. Louis. Messrs. Hoof and Harrison will make their headquarters at the North Hollywood, Calif., plant.

FRED E. WEICK, Engineering and Research Corp., and **A. P. FONTAINE,** Experimental Engineering Division, Bendix Aviation Corp., served as session chairmen at the National Light Aircraft Meeting of the Institute of the Aeronautical Sciences June 13-14. Among the speakers at the meeting were SAE members: **J. M. GWINN, JR.,** Consolidated Vultee Aircraft Corp.; **CARL T. DOMAN,** Aircooled Motors, Inc.; and **GROVER LOENING,** National Advisory Committee for Aeronautics.

ALBERT A. ARNHYM, on leave from Solar Aircraft Co. for a tour of duty with the Air Materiel Command, U. S. Army, has been made editor-in-chief of the AMC's Air Documents Division, Intelligence, T-2. His tour of duty, originally scheduled to end June 30, has been extended.

HENRY LOWE BROWNBACK of Norristown, Pa., returned recently from France where he had gone on a mission at the request of the French Minister of Industrial Production and the Societe des Ingenieurs de L'Automobile. Mr. Brownback has been in intimate contact with the French automotive industry for many years and is scheduled to return to France as part of another official mission in the near future. During his last visit he talked before an important meeting of the SIA.

SAE Members

Henry Ford II, president of Ford Motor Co., and Benson Ford, are interested listeners as Stephen F. Voorhees, designer in charge, explains details of the company's new $50,000,000 research and engineering center. Shown also are the three men who will supervise operation of the project when it is completed. Left to right: R. H. McCarroll, director of engineering and member of the SAE Technical Board; E. T. Gregorie, director of styling; Past-President William S. James, director of research; Benson Ford; Henry Ford II; and Mr. Voorhees. Messrs. McCarroll, James, Benson Ford, and Henry Ford are SAE members

President of Bendix

Malcolm P. Ferguson

MALCOLM P. FERGUSON, for five years a vice-president of Bendix Aviation Corp., was elected president to succeed **ERNEST R. BREECH** who resigned the post recently (see June *SAE Journal,* p. 38) to become executive vice-president of the Ford Motor Co. The son of the late **JOHN C. FERGUSON,** formerly president of the Eclipse Machine Co., the new Bendix president joined that organization upon his graduation from Syracuse University in 1919. Ten years later Bendix acquired Eclipse.

Formerly engineering draftsman with the R. K. LeBlond Machine Tool Co., Cincinnati, **WALTER A. WOOD, JR.,** is now layout draftsman with Glenn L. Martin Co., Middle River, Md.

Formerly a student member at M.I.T., Cambridge, Mass., **JAGAN P. CHAWLA** is now senior engineer in the flight research department of the Cornell Aeronautical Laboratory, Buffalo, N. Y.

J. F. WINCHESTER has been elected to the board of Davisbilt Products Co., Cincinnati, which is now affiliated with Liberty Aircraft Products Co., Farmingdale, Long Island, N. Y. An SAE member since 1910, Mr. Winchester has been with the Standard Oil Co. of N. J. for 35 years, retiring as of July 31 as manager of the company's automotive department. Long active in SAE technical and administrative committees, he was elected vice-president for T & M in 1933, served as SAE Councilor in 1934-1935, and was elected chairman of SAE Metropolitan Section in 1935 having served the Section in various capacities prior and since.

R. J. S. PIGOTT, chief engineer, Gulf Research & Development Co., Pittsburgh, was awarded the University Medal for Excellence at the commencement exercises on June 4 at Columbia University. Mr. Pigott, who is serving the SAE as Councilor, was also elected to Tau Beta Phi at Columbia in 1903, to Sigma Tau at Pittsburgh, in January, 1939, and in March, 1939, was elected to Sigma Xi at Columbia.

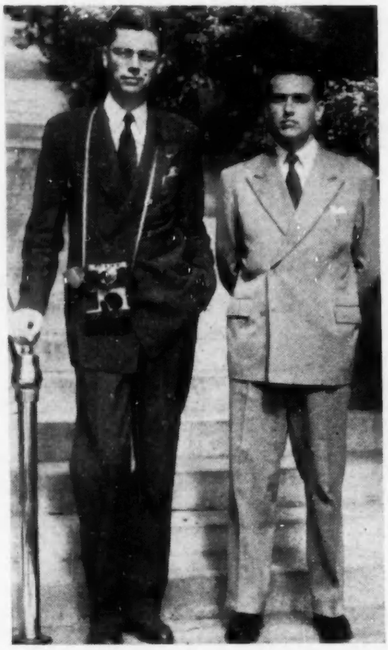
A. J. LANGHAMMER, president of the Amplex Division of Chrysler Corp., conducted a panel discussion of iron powder metallurgy at the annual Spring meeting of the Metal Powder Association held at the Waldorf-Astoria Hotel in New York City on June 13. The meeting was open to anyone interested in powder metallurgy.

BYRON C. FOY, who recently returned to civilian life after having served as a lieutenant-colonel in the Army Air Forces, has resigned as a vice-president of Chrysler Corp. and has been elected chairman of Jack & Heintz Precision Industries, Inc. He remains on the Chrysler board. The new company was formed in March with the

Byron C. Foy

merger of Jack & Heintz, Inc., and Precision Products Corp. **RALPH M. HEINTZ** is vice-president in charge of engineering of the new concern.

WALTER D. APPEL has been named assistant to the vice-president of engineering in charge of product development of Willys-Overland Motors, Inc. Mr. Appel was prod-



RALPH N. DuBOIS (left) who has been appointed to the technical staff of the Brazilian Aeronautical Commission, is shown with Artur Amorim of the Latin American commission. Formerly with Packard Motor Car Co. as chief experimental engineer of the aircraft division, Mr. DuBois, an active SAE Detroit Section committeeman, served that Section as 1944-1945 chairman. An SAE past vice-president representing Aircraft Powerplant Engineering, he has served on numerous technical and administrative SAE groups. His activities also include former chairmanship of the Meetings Committee of the Aircraft-Powerplant Activity Committee.

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uct development engineer with General Motors Overseas Operations, New York City, before joining Willys. A native of Cleveland, he was graduated from Case School of Applied Science in 1913 with a degree of B. S. in Mechanical Engineering. He began his engineering career with the National Lamp Works in Cleveland, and during World War I he joined Curtis Airplane Co. to design aircraft engines. He joined General Motors in 1925.

Improved synthetic rubber will be responsible for the future development of the 100,000-mile automobile tire is the prediction of **DR. R. P. DINSMORE,** vice-president of the Goodyear Tire & Rubber Co., made at a dinner held May 28, at the Recess Club, in Detroit. Addressing a group of Detroit newspapermen, Dr. Dinsmore said that the outstanding improvements in future tire development may very well come from synthetic rather than natural rubber.

Formerly assistant chief engineer, Lanova Corp., Long Island City, N. Y., **RAYMOND G. BENNETT** has become operations manager of the B and J Auto Spring Co., of New York City.

E. R. PRITCHARD has joined the engineering staff of the Automatic Transportation Co., Chicago. He was previously parts specialist, U. S. Army Quartermaster Corps, same city.

Applying knowledge of engineering to the problem of cooking pancakes, bacon, and steaks, **HARRY M. BRAMBERRY,** New Castle, Ind., developed a griddle of aluminum and heat-resisting plastic that thermodynamically holds the cooking surface at 500 F on an electric, gas, or coal range. For many years with the Perfect Circle Co., he has been a consulting automotive engineer since 1941, with a war period interruption when he was associated with Borg-Warner Corp.

J. EDWARD SCHIPPER, who recently resigned as president of Schipper Associates, has been appointed manager of the Detroit office of Kudner Agency, Inc. Mr. Schipper has headed his own advertising and public relations business in Detroit for 15 years.

LT.-COM. H. J. HUESTER, U. S. Navy Bureau of Aeronautics, has recently returned to Wright Field after flying 60,000 miles around the Equator and Pacific Area in a C-54 Douglas Skymaster with the Army Air Forces Tropical Science Mission, of which he was a member. The mission was overseas four months to study the prevalent causes of deterioration to Air Forces, Quartermaster and Signal Corps equipment in tropical regions.

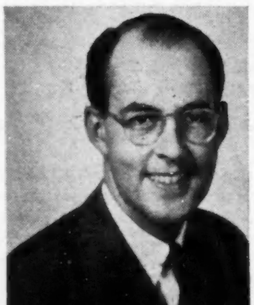
Formerly general manager of the S & S Tool & Mfg Co. of Detroit, **M. D. PEARCE, JR.,** has become assistant manager of Indian River Chevrolet Co., Cocoa, Fla.

RICHARD U. BRYANT, who had been production engineer with the Singer Mfg. Co., Bridgeport, Conn., is now process engineer with the Buick-Oldsmobile-Pontiac Assembly Division, GMC, Framingham, Mass.

R. A. LENNOX, formerly sales engineer for the Weatherhead Co., Chicago, has resigned in order to conduct his own business known as Sales Engineering Service, located in Chicago.

JOSEPH J. BROWN, who had been associated with Ford Motor Co. of Canada, Ltd., Windsor, Ont., is now technical sales engineer with Standard-Vacuum Oil Co., Inc., New York City.

ROBERT H. DAVIES has been named to head a new Engineering Division of the Parker Appliance Co., which will combine



Robert H. Davies

the previously separate functions of product development, product engineering, and technical service. With the Parker organization since 1939, Mr. Davies was formerly manager of Technical Service for the firm.

ROBERT M. WARD has been named district sales manager of the Champion Spark Plug Co. of Toledo, Ohio. He was formerly a special representative of the same company in San Francisco.

Formerly research engineer with the Hardy Metallurgical Co., New York, **GEORGE D. CREMER** is now a consultant specializing in powder metallurgy.

H. L. SCHNELL has recently joined Paramount Mfg. Co., Inc., of Hillsdale, Mich., as general manager. He was previously factory manager of Republic Aircraft Products, division of the Aviation Corp., Detroit.

E. J. HOBBS is now a member of the British Consulate, with headquarters at Cleveland, Ohio. He was until recently deputy assistant director, mechanical engineering, British Army Staff, Washington, D. C.

Formerly chief hydraulic engineer with Gar Wood Industries, Inc., Detroit, **JOHN C. MONAHAN** has recently formed the Hydraulic Accessories Co., same city, with which he is serving as chief engineer and sales manager.

FELIX E. WORMSER, secretary of the Lead Industries Association, spoke at the annual Spring meeting of the Association of American Battery Manufacturers held at Cleveland, May 23-24. **C. E. MURRAY,** Willard Storage Battery Co., president of the AABM, presided at the opening session of the meeting, and **H. D. WILSON,** Auto-Lite Battery Corp., was chairman of the technical session. **R. L. SOMERVILLE,** of the Electric Storage Battery Co., served as chairman of the merchandising session.

Previously research engineer with the Walker Mfg. Co., Racine, Wis., **HENRY G. LEINER** is now the owner of the North Riverside Garage in North Riverside, Ill.

E. W. STOEHR has been elected president of the Edro Lumber Corp., Brooklyn, N. Y. He was formerly assistant head of the engineering test department at General Motors Proving Ground, Milford, Mich.

HARRY KUHE has been named manager of the Chicago division of the Ethyl Corp. Mr. Kuhe joined the Ethyl organization in 1929, and after three years of service as a field representative in Chicago, he

Harry Kuhe

became assistant division manager in Tulsa. In 1940 he was appointed manager of the Seattle, Wash., division. Mr. Kuhe was 1945-1946 chairman of SAE Northwest Section.

Dr. Sidney M. Cadwell

DR. SIDNEY M. CADWELL has been appointed director of research and technical development of the United States Rubber Co. Formerly assistant general manager of the company's tire division. Dr. Cadwell brings to his new position 27 years of administrative and scientific experience in the fields of rubber and plastics. He joined the company in 1919 as a research chemist in its general laboratories, and in 1930, after 11 years of rubber and chemical research, he became director of tire development for the company with headquarters at Detroit. In 1945, he was appointed assistant general manager of the company's tire division with responsibility for production at its five major tire and tube plants. Some 65 patents have been issued to his credit, covering, among his other contributions, the development of improved antioxidants which have greatly increased the life of many types of rubber products. During the war years he did notable work in the development of synthetic materials and was among the first to recognize the value of butyl rubber for inner tubes and the use of rayon cord for improved tires.

ALLAN A. BARRIE, who had been assistant chief of staff operations, U. S. Army, Ferrying Division, Air Transport Command, Cincinnati, is now affiliated with Alvin P. Adams & Associates of Los Angeles, as a consultant.

Formerly senior mechanical draftsman at Young Radiator Co., Racine, Wis., **ALFRED A. WRIDT, JR.,** is now a layout draftsman with the Jacobsen Mfg. Co., same city.

NORMAN B. TICHENOR has been elected president of Petro Industries, Inc., Minneapolis, Minn., which is engaged in the manufacture and compounding of lubricating oils. He was formerly Chicago representative of Stanco Distributors, Inc.

HOWARD W. COLE, JR., a corporal in the U. S. Army, is now serving as a project engineer at Wright Field, Dayton, Ohio. Before entering the Army, he was senior test engineer with Wright Aeronautical Corp., Lockland, Ohio.

Formerly director of industrial engineering with the Crosley Corp., Cincinnati, **HAROLD W. CLOUD** has recently become affiliated with the National Pressure Cooker Co., Ltd., of Wallaceburg, Ont., Canada.

ARCHIBALD CRAIG, British Overseas Airways Corp., has been transferred from Baltimore, Md., to Dorval Airport in Montreal, Que., Canada, where he is in charge of propeller overhaul.

FRANK A. SUESS has become manager of sales and engineering of the Continental Oil Co., succeeding the late **B. E. SIBLEY.** Mr. Suess was Mr. Sibley's assistant for a number of years and is well-known throughout the industry. **E. W. CAVE,**

Frank A. Suess

chairman-elect of the SAE Mid-Continent Section, moves up to Mr. Suess's previous position as assistant manager of sales and engineering.

CLARENCE W. CUSTER, who is president of the American Stamping Co., Cleveland, has been elected president of the **Pressed Metal Institute of Cleveland.**

Formerly an engineer with General Electric Co., Lynn, Mass., **DALE D. STREID** is now associated with the Monsanto Chemical Co., Clinton Laboratories, Knoxville, Tenn.

LT.-COM. NEIL A. SMITH, Royal Canadian Navy, has been appointed to the Department of National Defense, Naval Service, Ottawa, Canada, as director of air engineering. He was formerly director of aircraft maintenance and repair, with headquarters at London, England.

RALPH E. MIDDLETON has become a partner with the Variety Development and Engineering Co. of Los Angeles, which is engaged in the manufacture of toys and other novelties. Mr. Middleton, who is vice-chairman representing aircraft engine activity for SAE Southern California Section, was formerly vice-president in charge of operations for the Aireon Mfg. Corp., Burbank, Calif.

Until recently an engineer with the Elliott Co., Jeannette, Pa., **F. E. FULLER** is now associated with the development engineering department of Consolidated Vultee Aircraft Corp. Vultee Field, Calif.

COL. GEORGE C. CROM, JR., U. S. Army, is now on terminal leave after serving more than five and one-half years of active duty with the Army Air Forces. His long military service was highlighted by his outstanding contributions to the development of aircraft electrical equipment while he was assigned to the Equipment Laboratory of the Engineering Division at Wright Field. Colonel Crom will continue to serve in a civilian capacity at Wright Field as a research consultant in the Equipment Laboratory.

P. B. Taylor

United States production of the Rolls-Royce Nene and Derwent jet engines will be undertaken by the Taylor Turbine Corp., headed by **P. B. TAYLOR,** former vice-president and general manager of Wright Aeronautical Corp. The new engineering organization expects to be in production on these aircraft powerplants early in 1947. They are today's most powerful jet engines, Mr. Taylor said.

TURNER A. DUNCAN has been named assistant to the chairman of the board of ACF-Brill Motors Co. of Philadelphia. He was until recently affiliated with Eclipse-Pioneer Division of Bendix Aviation Corp., Teterboro, N. J.

CAPT. JOHN I. CICALA, who had been with the Office of the Quartermaster General, Fuels & Lubricants Division, Washington, D. C., is now with the Texas Co., Technical Service Division, product application department, Beacon, N. Y., as a mechanical engineer. Recently he was awarded the Army Commendation Ribbon, for services rendered in the fuels and lubricants field.

Formerly a student member at the University of Colorado, **C. R. WALKER, JR.,** is now associated with Consolidated Vultee Aircraft Corp., San Diego, Calif.

Formerly field engineer with Wright Aeronautical Corp., **B. W. MOORE** is now an engineer with the California Research Corp., Richmond, Calif.

LT. LEWIS GWYN, JR., since his discharge from the Navy on April 2, has been connected with Starr, Duff and Smith, exporters of vehicles and automotive equipment. Mr. Gwyn has already returned from a trip to Mexico City where he organized

Honorary membership in Tau Beta Pi, national honor association of engineers, was conferred on Past-President **H. W. ALDEN** (right) and H. S. Ellington (center) at the annual meeting of the Detroit Chapter in May. Colonel Alden and Mr. Ellington were chosen from a group of 30 nominees, upon recommendation of a committee of past-presidents of the Chapter, in recognition of their outstanding contributions to the field of engineering.

a truck body shop. Within a few weeks, he will leave for Manila to put another body shop in operation. Mr. Gwyn expects to make his home in Manila.

HARRY L. SHOWALTER, JR., has recently joined the Chambersburg Engineering Co. of Chambersburg, Pa., as assistant sales manager. The company specializes in the manufacture of impact die forging equipment, such as steam and air hammers and presses.

Formerly a student member at Yale University, New Haven, Conn., **JOHN R. DANLY** is now an ensign in the USNR.

JOHN A. MINER has been appointed mid-western sales representative for the Lipe-Rollway Corp. of Syracuse, N. Y. Before joining the Lipe-Rollway organization, Mr. Miner was associated with Vickers, Inc., of Detroit, and prior to that was affiliated with John Deere Tractor Co., of Waterloo, Iowa.

John A. Miner

DR. WILLIAM A. MUDGE has been elected chairman of the New York Chapter of the American Society for Metals to serve during the year 1946-1947. Dr. Mudge, who is assistant director of the Technical Service of the Development and Research Division, International Nickel Co., New York City, has served the ASM during the past year as chairman of the Technical Program Committee.

WALLACE J. SQUIRE has recently become works manager of the Telephone Division of the Federal Telephone & Radio Corp., Clifton, N. J. He was assistant to the president of the U. S. Time Corp., Waterbury, Conn.

ARTHUR L. BRADLEY has become chief engineer of Detroit Sales Engineering, Detroit. He was until recently chief product engineer of the Cook Engineering Co., same city.

HAROLD L. GEIGER, head of the Chicago technical section of the Development and Research Division of the International Nickel Co., Inc., has been elected chairman of the Chicago chapter of the American Society for Metals for the year beginning September, 1946. During the past year he served as vice-chairman of the same chapter. Before joining the International Nickel organization, Mr. Geiger was chief metallurgist for the Wisconsin Steel Co. and was also associated with the operating and metallurgical departments of the Inland Steel Co.

J. K. MILLER, Wagner Electric Corp., has been transferred to the Boston office where he is manager of the automotive branch. He was formerly at the New York Branch of the same firm.

TOM O. DUGGAN has resigned as vice-president in charge of the Service Division of Thompson Products, Inc., and will live in California where he started his career in the automotive parts distributing industry 32 years ago. Mr. Duggan said he had no definite plans for the future aside from taking a vacation after seeing 15 years' service with Thompson Products, and developing his personal affairs on the west coast. In announcing Mr. Duggan's resignation, president **F. C. CRAWFORD,** of Thompson Products, stated that it was "accepted with keen regret by our management . . ." Mr. Duggan joined Thompson Products as merchandising director in 1931 after being with the National Standard Parts Association. He was made general manager of the Thompson Service Division in 1936, and a vice-president in 1942.

Tom O. Duggan

JOHN K. ANTHONY has opened offices in Cleveland as a consultant on bearings and bearing metals. He was formerly director of the metallurgical department of the Cleveland Graphite Bronze Co., Cleveland.

JOHN W. HORNER has become engine project engineer for the Nelson Specialty Welding Equipment Corp., San Leandro, Calif. He had been assistant chief engineer in charge of the engineering department of the Righter Mfg. Co., Burbank, Calif.

PAUL R. BELANGER, who has been assigned to Douglas Aircraft Co., Inc., Santa Monica, Calif., during the war, has returned to Canadair, Ltd., and may be reached at Montreal, Que., Canada.

MICHAEL A. REMONDINO, research engineer with the Ethyl Corp., has been transferred from the Detroit Engineering Laboratories to the San Bernardino, Calif., laboratory.

Formerly assistant group engineer, Sikorsky Aircraft, division of United Aircraft Corp., Bridgeport, Conn., **MICHAEL A. PARADISO** has now become design engineer with Douglas Aircraft Co., Inc., Santa Monica, Calif.

Until recently chief design engineer with the Romec Pump Co., Elyria, Ohio, **LELAND MELVIN** is now affiliated with the A. W. Hecker Co., Pump Division, Cleveland, where he is serving in a similar position.

Formerly engineer in charge of transmission controls rotors, Kellett Aircraft Corp., Upper Darby, Pa., **W. H. PEARSON** has become chief engineer of the F. T. Griswold Mfg. Co., Wayne, Pa.

C. J. MURPHY has recently become affiliated with the American Gas Furnace Co., of Elizabeth, N. J., as assistant superintendent.

Previously engine tester, Pratt & Whitney Aircraft, division of United Aircraft Corp., East Hartford, Conn., **ABBOTT F. RAND** is now assistant manager of the Andover Steam Laundry, Andover, Mass.

ROBERT A. COLE has recently become affiliated with Boeing Aircraft Co., Seattle, Wash., as associate engineer of research.

Formation of a new company to be known as the Parkway Foundry Corp. was recently announced by **EMILE C. MATHIS,** who is also president of the Matam Corp. of Long Island City, N. Y. The new company, which will produce non-ferrous castings by the sand, permanent mold, and centrifugal methods, has opened a new plant in Brooklyn, N. Y. Mr. Mathis was known abroad as the "Henry Ford of France," where he manufactured the Mathis car, and also, by agreement with Henry Ford, the Ford, Lincoln and Mercury.

Emile C. Mathis

V. O. GRIFFIN, who had been a lieutenant engineer with the Royal Canadian Navy Volunteer Reserve, Esquimalt, B. C., Canada, has joined the B. F. Goodrich Rubber Co., Kitchener, Ont., as assistant engineer.

Formerly section head, Wright Aeronautical Corp., Lockland, Ohio, **W. W. CARY, JR.**, is now machine load analyst with International Harvester Co., Chicago.

H. A. REINHART has recently become affiliated with the Roll-Rite Corp., formerly the Pacific Industrial Products Co., of Oakland, Calif., as an industrial engineer and adviser on design.

JAMES P. STEWART has recently joined the De Laval Steam Turbine Co., Trenton, N. J., as special representative for the sales department. He was formerly assistant general manager of B-W Superchargers, Inc., Milwaukee.

Formerly alignment engineer with Hamlin Neiney, Los Angeles, **EVERETT S. ALLEN** is now technical engineer (sales) with the West Coast Lubri Gas Co., same city.

HAROLD T. JARVIS has recently become affiliated with the Murch-Jarvis Co. of St. Louis, Mo. Mr. Jarvis is currently on a leave of absence from Pratt & Whitney Aircraft, East Hartford, Conn.

CHARLES R. SECORD has recently joined Chance Vought Aircraft Division of United Aircraft Corp., Stratford, Conn., as cost estimator in the planning department.

GEORGE W. YANSS has recently joined Kaiser-Frazer Corp., Willow Run, Mich., as special assignment engineer. He was previously sales engineer with Flex-O-Tube Co., Detroit.

Formerly a student member at Purdue University, West Lafayette, Ind., **GEORGE R. WACHOLD** is now an ensign in the USNR and is stationed at Moffett Field, Calif.

Previously U. S. Government examiner, Reconstruction Finance Corp., Baltimore, Md., **HAROLD E. ROE** has become maintenance engineer with the Bannings Service Center, Federalsburg, Md., DeSoto and Plymouth dealer.

ROGER F. WINCHESTER has joined the Fowler Engineering Co. of Spring Valley, Calif., as a machinist. He was formerly a project liaison engineer with Consolidated Vultee Aircraft Corp., San Diego Division.

Until recently senior engineer, Aeroproducts Division, General Motors Corp., Vandalia, Ohio, **H. ROGER WILLIAMS** is now an architect with offices in Palm Springs, Calif.

Formerly executive engineer with Republic Aviation Corp., Farmingdale, L. I., N. Y., **R. WENDELL MILLER** has recently become assistant business manager of the commercial airplanes section of the Glenn L. Martin Co., Baltimore, Md.

ROBERT HUNT, who had been general superintendent, motive power, Seaboard Air Lines Railway, Norfolk, Va., is now designing and testing engineer with the Berkley Machine Works & Foundry Co., Inc., same city.

DAVID KALISH has joined Alliance Mfg. Co. of Alliance, Ohio, as project engineer. He was formerly senior engineer with Curtiss-Wright Corp., Airplane Division, Buffalo, N. Y.

ROBERT L. HEATH, metallurgical engineer with the Climax Molybdenum Co., has been transferred from St. Louis, Mo., to the New York City branch of the company.

CLINTON RECTOR has recently become vice-president of National Engineering Products, Inc., Washington, D. C. He was formerly general sales manager of the Catalin Corp., New York City.

Until recently experimental engineer with the Studebaker Corp., South Bend, Ind., **H. B. STONE** is now project engineer with Kaiser-Frazer Corp., Willow Run, Mich.

Formerly a student member at Yale University, New Haven, Conn., **ROBERT E. TSCHIRCH** is now test engineer with Pratt & Whitney, division of United Aircraft Corp., East Hartford, Conn.

GEORGE E. ROWBOTHAM has joined the engineering department of Fisher Body Ternstedt Division, General Motors Corp., Detroit, where he is serving as project engineer. He was previously mechanical engineer with Curtiss-Wright Corp., Propeller Division, Caldwell, N. J.

CHARLES S. STONE, who had been project engineer with the NACA Aircraft Engine Research Laboratory in Cleveland, Ohio, is now development engineer with Airesearch Mfg. Co., Inglewood, Calif.

Formerly a lubricating engineer in the Philadelphia branch of the American Oil Co., **RALPH V. MARTIN** is now serving in a similar capacity in the Roanoke, Va., branch of the same company.

H. G. ERICKSON has recently joined Luscombe Airplane Corp. of Garland, Tex., as chief structural design engineer. Previously he was preliminary design engineer with Beech Aircraft Corp., Wichita, Kans.

FRED G. FERGUSON has recently become affiliated with the Effco Products Co. of Cleveland. He was, before joining the Effco organization, president of the Simplex Products Corp., same city.

Formerly a student member at Yale University, New Haven, Conn., **WILLIAM W. CARLTON** has become a junior flight test engineer with the Glenn L. Martin Co., Middle River, Md. He plans to return to C.I.T. for graduate work late in 1946.

ARMAND W. WOTHE has recently joined the Heil Co. of Milwaukee, Wis., as engineer in charge of the Body & Hoists Division. He was formerly experimental engineer with the Wisconsin Axle Division of Timken-Detroit Axle Co.

G. F. RACETTE has become associated with United Tire & Accessories Co. of Tulsa, Okla. He was formerly vice-president of the Bareco Oil Co., same city.

PAUL W. LATHAM, JR., who had been a student member at Yale University, New Haven, Conn., is now employed at Waukesha Motor Co., Waukesha, Wis., where he is engaged in detail drafting work.

Formerly staff engineer with Culver Aircraft Corp., Wichita, Kans., **WILLIAM F. WRIGHT** has joined Boeing Airplane Co., Wichita Division, as head engineer in the project design group.

FRANK R. WEST has been named vice-president and manager of the Calaveras Nevada Mining Corp., San Andreas, Calif. He was previously vice-president in charge of engineering of the Excel Foundry & Machinery Co., Inc., Fall River, Mass.

IRVING L. ROSS has become chief engineer of Ross Engineering Associates of Fort Worth, Tex., designers of tools, dies, jigs, and fixtures. He was a tool engineer with the Robbins Engine Co. of Detroit.

ARTHUR P. FRAAS has been named assistant professor at the Case School of Applied Science, Cleveland. He was formerly senior test engineer with Packard Motor Car Co., Detroit.

JOHN TILL, who had been fleet superintendent with Regal Laundry, Inc., Baltimore, Md., has opened a service station and garage at Fleetwood, Pa. The garage, which is now in the construction stage, is scheduled to be completed the latter part of July.

LOUIS S. WOOD has recently become a partner in the Wood-Work Co. of San Francisco, Calif., manufacturers of hydraulic hoists and bodies and also dealers in motor truck equipment.

THOMAS J. LESTER has been elected president of National Molded Products, Inc., Euclid, Ohio, manufacturers of die cast parts. He was until recently production manager of the Tool & Die Division of the Lester Engineering Co., Cleveland.

L. E. GALBRAITH has been placed in charge of the newly established Chicago sales office of Thompson Products, Inc. Mr. Galbraith has been associated with the Thompson organization for 25 years in various sales capacities and is well qualified for his new assignment in the rapidly expanding Chicago area.

V. M. DOBEUS has been elected president of the Tractomotive Corp. of Findlay, Ohio, a new company formed to manufacture earth moving equipment for industrial crawler and wheel tractors. He was formerly chief engineer, Allis-Chalmers Mfg. Co., Springfield Works, Springfield, Ill. Mr. Dobeus is a member of the SAE Tractor and Farm Machinery Activity Committee.

CHARLES W. McALLISTER, chief aviation engineer with Sinclair Refining Co., is now with the Aviation Sales Division of the New York office.

FRED J. RODE has recently become affiliated with the Verson Engineering Co. of Toledo, Ohio, as executive vice-president. Before joining the Verson organization, Mr. Rode was works manager and chief engineer with the E. W. Bliss Co.

Formerly associated with Wilesco Products Co., Boonton, N. J., **WESLEY L. SMITH** is now the owner of the Edson Engineering Co. of New York City.

J. W. WALKER is now the owner of Walker Laboratories of Dallas, Tex. He has recently severed his connection as group leader with Magnolia Petroleum Co., same city.

Formerly sales engineer with General American Aerocoach Co., Chicago, **ERNEST M. LUNDA** is now affiliated with Mack Mfg. Corp., New York City.

C. A. KERKLING has been elected president of Kerkling & Co. of Burbank, Calif. He was formerly a partner of the firm with headquarters in Hollywood, Calif.

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Successful Summer Meeting

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On this point, Mr. Nutt pointed out that the comparisons are being made, in any case, with a reciprocating engine that is highly developed and a jet engine that is just beginning to be developed, so that it seems as if the jet engine has a large field for development ahead of it.

The possibility of thrust augmentation was discussed by Mr. Taylor, such as the use of a tailpipe burner or reheating between stages, which gives benefits particularly at high compressor ratios. He felt, however, that for the present we should concentrate our attention on the basic machine until we get out of it all the power that is possible before we spend time on trick devices.

FUELS AND LUBRICANTS SESSIONS

Chairmen

J. M. Campbell **A. L. Beall**

New frontiers in the knowledge of lubrication were investigated in the two Fuels and Lubricants sessions where six outstanding papers were presented. Stimulating discussions followed, disclosing that a vast amount of research work must be done before the phenomenon of lubrication and combustion is understood.

A Visual Study of Cylinder Lubrication— MILTON C. SHAW and THEODORE J. NUSSDORFER, JR., Aircraft Engine Research Laboratory, NACA.

(*Presented by Mr. Nussdorfer*)

FIRST visual study of cylinder lubrication, employing an engine equipped with pyrex sleeve, operating at speeds up to 1000 rpm, maintaining constant cylinder-head pressures from 0 to 50 psi, and a camera, with illumination by scattered, fluorescent, and stroboscopic light techniques, has established, among other, the following data:

- Pistons are inclined in such a direction as to favor an oil wedge on the loaded side of the cylinder during the greater portion of the engine cycle, supporting the hydrodynamic theory.
- Pistons move laterally from the major-thrust to the minor-thrust face of the cylinder under the influence of piston side-thrust.
- The amount of lubricant on the skirt varies with the relative angular position of the piston rings and with cylinder pressure.
- Ratio and direction of piston ring rotation varies with cylinder-head pressure and engine speed.
- Piston rings rotate as rapidly as 1 rpm at engine speeds of 1000 rpm.
- When operating under load, the approximate thickness of an oil film on the piston-ring face is 0.0001 in., or less.

The test engine was a two-cylinder, 3.125 x 4.375 in., 90-degree vee, fitted with aircraft-type pistons. One cylinder block was replaced with a special unit holding a sleeve of 0.25 in. pyrex glass. The standard head was replaced by a 2000 cu in. cylindrical pressure chamber, fitted with pressure gage, safety-relief valve, and connection to a nitrogen cylinder. Quartz fibers of 0.001 in. diameter were mounted above and below the piston to permit study of piston orientation, light lines along the edges being used for references. Measuring microscopes were mounted on the cylinder block and focused on the quartz fibers.

New methods were employed to make the thin film of oil readily visible. One employed the scattered-light technique. Light entered the space between piston and cylinder wall at a grazing angle when this space was completely oil-filled. A fluorescent dye in the oil increased the intensity of the light to be scattered. Some scattered light left the cylinder, resulting in sensations of light at oil points where there was an oil film, of darkness where no film existed.

In the fluorescent-light method, the glass cylinder was directly illuminated by long-wave ultraviolet radiation from which all visible light had been filtered. In this beam of so-called "black light," the fluorescent oil emitted a visible light. Invisible ultraviolet rays were reflected from points uncovered by oil film.

Photographs disclose that the piston does not move violently from one cylinder face to the other as the piston side-thrust changes direction. Instead, this lateral movement occupies a considerable portion of the stroke; is greater at low speeds and heavy loads.

Piston Lubrication Phenomena in a Motored Glass Cylinder Engine—S. J. BEAUBIEN and A. G. CATTANEO, Shell Development Co.

(*Presented by Mr. Beaubien*)

MOVEMENT of piston rings, and of oil in the ring belt, during engine operation, and some of the reasons for varying rates of consumption of lubricants, have been revealed by novel stroboscopic and photographic studies of an engine fitted with a glass cylinder. While the effects only of mechanical forces were observed by motoring the engine without combustion, and it is admitted that high temperatures and pressures will influence oil distribution under actual operating conditions, it was possible to obtain a qualitative picture of the way in which the rings move in their grooves and of the mechanism whereby the oil passes the rings from the oil sump to the combustion chamber.

This picture shows that when the piston starts moving down, shearing and acceleration forces keep the oil in the ring groove. As the downward movement continues, oil moves to the bottom of the groove, but cannot leave because the relative motion between piston land and cylinder wall sets up shear forces which function as a simple viscosity pump. The ring remains on its upper seat by force of side wall friction. When the piston reaches bottom dead center, velocity, side-wall friction force on the ring, and shearing force all approach zero. The acceleration force, however, is near maximum, and the oil runs from the groove as the ring comes against its lower seat.

During the first half of the upstroke, both shearing and acceleration forces keep the oil in the groove and the ring on its lower seat. As the upstroke continues, shearing and friction forces due to velocity again oppose the acceleration force. Oil flows to the top of the groove, but is prevented from leaving by the viscous pumping of the shearing force.

The top ring appears to change from lower to upper seat at a crank angle of 345 deg. The ring squeezes the oil from the groove space above it, part being forced out over the top land, the rest back into the groove. Two crank degrees later the oil squeezed out over the piston land is thrown into the combustion chamber.

The tests suggest that a major fraction of oil consumption occurs through the motion of the ring in its groove; anything which would hold the ring on its lower seat when the piston nears top dead center could reduce oil consumption. Also, certain operating conditions seem to favor oil pumping on the compression stroke. A low manifold pressure and retarded spark, compression and combustion pressures can be sufficiently low to permit the ring to rise in its groove, even at low engine speeds. Oil consumption can be doubled by retarding the spark 15 degrees.

Engine speed also can promote oil pumping on the compression stroke. As the speed is increased, the acceleration force tends to lift

the ring from its seat earlier in the cycle. Lower compression forces permit the ring to move even sooner, suggesting reasons why most engines appear to lose control over oil consumption at some definite critical speed.

DISCUSSION

While Messrs. Beaubien and Cattaneo stated that pressures influence oil distribution, experiments with a current-model motor truck engine operated at constant speed with various loads in the Perfect Circle Engine Laboratory, according to Karl H. Effman, disclosed that:

- Highest rate of oil consumption was obtained when engine was motored with closed throttle.
- Lowest rate of oil consumption was obtained when engine ran with no load.
- Oil consumption increased with the load.

Findings in this laboratory are in disagreement with the authors' statement that anything holding the ring on its lower seat at top dead center reduces oil consumption. These findings differ also with the report that at some definite critical speed most engines appear to lose control over oil consumption. Oil consumption at high engine speeds appears to be just as consistent, if not more so, than at low speeds.

Erratic oil consumption was experienced at high speeds only when rings, because of poor design or application, leave the cylinder wall. This ring flutter itself is erratic, infrequently developing at the same speeds even under controlled conditions. With a proper engineering ring installation, no flutter should occur throughout the entire range of engine speeds and loads.

A. L. Beall, Wright Aeronautical Corp., reported that studies of these types provide light where before there was only darkness and certainly work to substantiate long range deductions and to confirm the reasoning of current engine designers. Experiments in Wright laboratories have shown that lining-up ring gaps does not necessarily increase oil consumption; also that there is no serious difference between free and pinned rings so far as oil consumption is concerned.

Analysis of a Shock-Excited Transient Vibration Associated with Combustion Roughness — ARTHUR S. FRY, JOHN STONE and LLOYD WITHROW, Research Laboratories Div., General Motors Corp.

(*Presented by Mr. Withrow*)

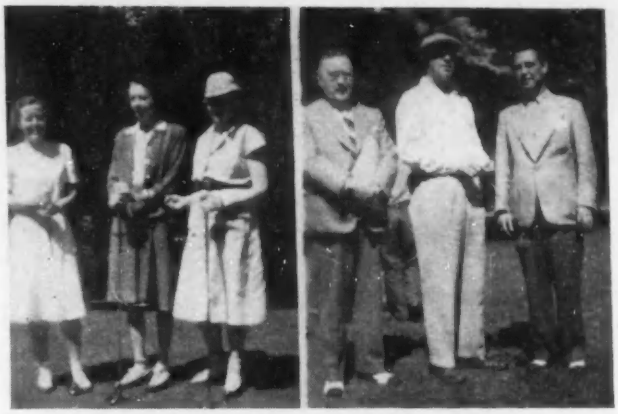
EXPERIMENTAL work on the relationship between combustion pressures in the cylinders and shock-excited transient flywheel vibrations in eight-in-line and single-cylinder test engines has facilitated development of a combined theoretical and mathematical analysis of the crankshaft-flywheel system. Objective of the analysis is to find characteristics of the pressure development which are most effective in exciting this vibration over the normal range of engine-operating conditions.

Results indicate that low rates and accelerations of pressure rise, obtainable within certain limits by proper combustion chamber design, will reduce combustion roughness at low engine speeds, but that at high speeds maximum pressures must be lowered. Since requirements impose serious limitations on the designer of combustion chambers, it is believed that more may be gained in solving the roughness problem by altering the mechanics of the vibrating system than by controlling combustion chamber shapes.

Changes in combustion chamber design appear to diminish roughness at some engine speeds, to increase it at others. For instance, at 3500 rpm the degree of shock excitation rises as the maximum pressure is increased, yet this variable does not affect the degree of shock excitation appreciably at 1000 rpm. On the other hand, while the degree of shock excitation of the flywheel vibrations increases with rising values of the rate and acceleration of the pressure at 1000 rpm, at 3500 rpm rising values of the rate of pressure rise diminish the degree of shock excitation. Changes in acceleration of pressure rise have little or no effect.

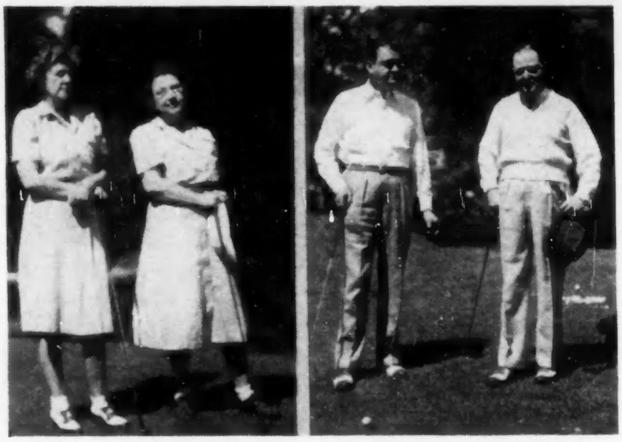
Studies of eight-in-line engines disclose that control of roughness by proper design of the mechanical system demands elimination of all types of resonance. With an eight-in-line at high speeds, the inertial forces add together with the gas loads in cylinder 7 to produce excessive vibrations at one point in the cycle. Then, a degree of resonance may occur if the free vibrations are not completely damped out before a second impulse is applied. Free vibrations produced by cylinder 8 contribute to the response of the flywheel when combustion occurs 180 crankshaft degrees later in cylinder 7. Between 3500 and 4000 rpm these vibrations are antiphased. The free vibrations from cylinder 8 tend to diminish the response of the flywheel to the gas load in cylinder 7.

The problem consequently resolves itself into a two-phase solution — first, removing the violent flywheel deflections caused by the inertial forces, and then properly controlling the degree of damping of the lateral flywheel vibrations.



Mrs. M. D. Archangeli, Mrs. J. H. Bolles, and Mrs. F. C. Barrows ready to swing into action, and E. B. Ross, F. C. Barrows and J. J. Cooper

Some were noisy, most of them shook with the infirmities of age, but they all ran — to the delight of the onlookers and drivers — many of whom had a hand in building these automobiles which were destined to change the American way of life



Mrs. C. W. Kalchthaler, women's golf champion, with Mrs. C. N. House (left). A. C. Chambers and E. W. McIntosh (right), meet on the links

DISCUSSION

Important contributions here have been made to study of the entire subject of combustion roughness. While the evidence presented by Messrs. Fry, Stone, and Withrow tends to ascribe the cause to deflections of engine parts, the interpretation of results tends to be too narrow and fails to establish that combustion chamber design is not the basic and pertinent factor, Robert N. Janeway, Chrysler Corp., said.

Combustion roughness in the medium speed range is definitely ascribable to combustion chamber design, and even at high speeds it is a highly pertinent factor. Since detonation is being eliminated by better fuels, combustion shock becomes increasingly important.

The effects both of combustion chamber design and parts deflection are difficult to understand, but it is becoming possible to narrow the difference between experimentation and analysis in this field, Alex Taub, consulting engineer, pointed out. Combustion roughness definitely is present in all types of engines at speeds below 3500 rpm, and the effects vary. Evidence here presented tends to support the conclusion that the practical approach appears to be to design the shortest possible engine with the largest possible cross-section, thus positively decreasing deflection.

Recent Developments in Universal Gear Lubricants – P. V. KEYSER, Socony-Vacuum Oil Co., Inc.

CONSIDERABLE progress was made in the definition and testing of universal gear lubricants by the Coordinating Research Council for the Army Ordnance Dept. during the war. In undertaking the job of improving tests and developing new ones around which a new universal gear lubricant specification could be written, it was necessary that the specification be non-restrictive as to type of additive employed and yet insure procurement of lubricants capable of meeting current and anticipated military requirements.

High-speed test data, obtained at the Aberdeen Proving Grounds and confirmed by a series of 24,000-mile road tests, formed the basis of a new high-speed gear test that was later incorporated in the new Army universal gear lubricant specification, 2-105B. In describing this specification, Mr. Keyser reported that the increased viscosity of the 75 grade at 100 F was warranted by extensive low temperature transmission shifting and torque tests which indicated that a viscosity as high as 350,000 SUS could be tolerated in military service. The higher viscosity provides greater protection against gear case leakage in the higher temperature ranges for which this grade is recommended.

Inclusion of a minimum flash point was recommended to minimize evaporation losses and to guard against the use of too light a distillate stock in the base oil of the 75 grade lubricant stock. The copper strip activity test, to determine the chemical activity of the lubricants toward copper, was modified to prevent sludging characteristics at temperatures in excess of 225 F.

The qualification tests, high speed road test and high torque test, are the heart of the specification, Mr. Keyser related, and should be the basis of any evaluation or development of new lubricants or addition agents. These are real lubricant performance tests utilizing military gears under conditions representing military service and requirements.

Other phases of the specification cover tests for moisture corrosion, storage solubility, foaming, and general qualification.

Low-Speed, High-Torque Testing of Gear Lubricants for Hypoid Axles – A. O. WILLEY, Lubri-Zol Corp.

ADEQUATE lubrication under low-speed, high-torque performance is considered by equipment manufacturers and operators to be one of the most essential requirements in the field. Many lubricants that gave completely satisfactory results with early hypoid gears in all other applications developed serious trouble under this condition, Mr. Willey disclosed.

Lack of fundamental knowledge has been a serious handicap in the development of satisfactory gear lubricant test methods. Little information is available on basic items of actual contact areas, surface temperature, and unit pressures between gear teeth under load.

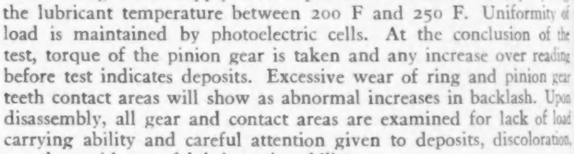
Operation of a full scale truck axle under simulated road service conditions is specified by the Army in high-torque low-speed tests. One type of equipment used, known as a four-square machine, employs two rear axle assemblies, one of which is under test while the other serves to complete the power transfer circuit. Another type of installation uses a single rear axle unit with high capacity absorption dynamometers coupled to each of the axle shafts.

After measuring the backlash between ring and pinion gear teeth, the speaker related in describing the test procedure, the carrier is installed in the housing and the torque required to rotate the pinion shaft is measured. This turning effort represents a summation of the resistances of the bearings, gears, and various lubricant seals under no load condition.

A cooling water supply line is provided for automatically cycling the lubricant temperature between 200 F and 250 F. Uniformity of load is maintained by photoelectric cells. At the conclusion of the test, torque of the pinion gear is taken and any increase over reading before test indicates deposits. Excessive wear of ring and pinion gear teeth contact areas will show as abnormal increases in backlash. Upon disassembly, all gear and contact areas are examined for lack of load carrying ability and careful attention given to deposits, discoloration, or other evidence of lubricant instability.

High Speed Testing of Gear Lubricants for Hypoid Axles – C. E. ZWAHL, Chevrolet Motor Division, General Motors Corp.

A GEAR lubricant for hypoid axles must satisfactorily lubricate the passenger car at high speed operation and the truck at high speeds and low speed-high torque to be considered acceptable by the vehicle manufacturer, Mr. Zwahl advised.



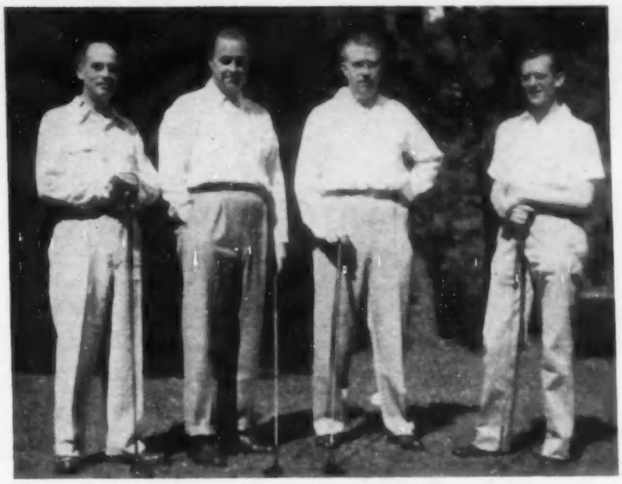
Frank Jardine, J. J. Cooper, Carl Kalchthaler, SAE Past-President H. T. Woolson, and C. H. House take a round of recreation between technical sessions

The only suitable test by which the lubricating qualities of a gear lubricant for a passenger car hypoid axle can be determined is to put the lubricant in the axle under a car and run the car at high speeds. If the gear teeth are not scored or scuffed after the test, the lubricant is satisfactory.

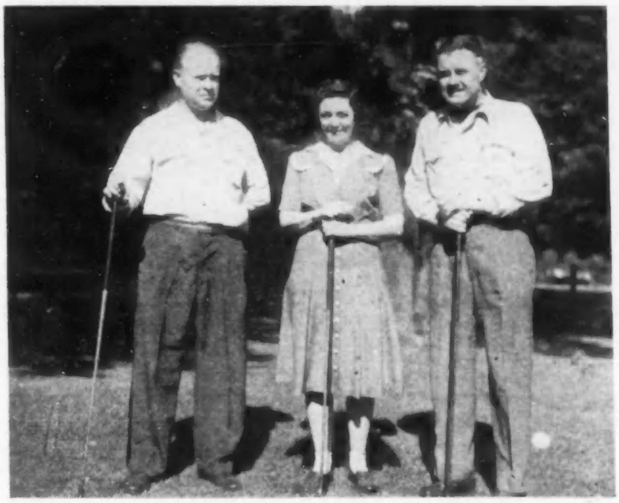
A test procedure developed by General Motors includes a continuous high speed run of 38 miles at 75 mph and a shock test. The high speed test includes a series of repeated accelerations and decelerations and clutch engagements and disengagements with the ignition turned off. In the shock test, the car is driven in second gear to 50 mph; then the clutch is disengaged and the ignition turned off. After attaining a coasting speed of 45 mph, the clutch is quickly engaged with the transmission in second gear and the ignition off. The purpose of the continuous high speed test, the speaker related, is to test the drive side of the teeth whereas the shock test primarily tests the coast side of the teeth.

Similar tests have been developed for the Army by the Coordinating Research Council at the request of the Ordnance Department which, the CRC Gear Lubricants Advisory Group feels, can be adopted as an industry-wide specification.

The CRC procedure permits testing of the lubricant in a road test or on a chassis dynamometer. Dynamometer testing is desirable in that it permits easy duplication of test conditions and provides a facility permitting high speeds without danger of conflicting with the law.



D. D. Robertson, M. B. Terry, E. F. Petsch, and F. R. Nail ready to try their own, and assay the others' skills



D. T. Peden, with Mrs. L. S. Martz and her husband

DISCUSSION

Wayne Goodale, Standard Oil Co. of Calif., said that as a manufacturer of gear lubricants he visualized these four basic requirements in establishing a suitable lubricant:

• It must be satisfactory to the military;

• It must be satisfactory for passenger car use;

• It must be satisfactory for civilian heavy duty truck and bus use, and

• The civilian replacement service must be taken into consideration.

He pointed out that since the military equipment of the future will be to a large extent the civilian equipment of that time, it would be advantageous to use types of lubricants that civilians are to use and for which there are large supplies and manufacturing facilities.

Since the adoption of 2-105-B is not an emergency move it would be an advantage to select a type of lubricant that meets all four requirements.

R. P. Lewis, Spicer Manufacturing Corporation, congratulated Mr. Zwahl on his paper on "High Speed Testing of Gear Lubricants for Hypoid Axles."

He held that the method of testing should become standard to avoid the confusion that has existed in the past. He said that in building hypoid axles since 1927, the lubricant has always been the first problem.

Mr. Lewis further felt that the bump test is the most reliable and the most direct. He was glad to see that the severity of the old "Chevrolet Bump Test" had been considerably reduced since he had always believed that the loads imposed by the test were far beyond those actually received in service.

Mr. Lewis has used a similar test for many years which is much less severe and is very satisfactory. The test consists of:

1. Driving car not over 50 mph for 10 miles to bring lubricant up to temperature,

2. Accelerating from 40 mph to 75 mph and maintaining speed from 65 to 75 mph for 10 miles,

3. Repeat item 2 two times,

4. Drive 75 mph in high gear. Disengage the clutch. Do not turn off switch. Coast to 65 mph. Engage clutch as rapidly as possible,

5. Repeat item 4 two times.

The most attention is paid to testing up to this point as experience has proved that this test closely approximates actual service conditions.

Mr. Harry Wolfe, Research Laboratories Division, GMC, said that the so-called "Chevrolet Test" is erroneously referred to as a bump test, whereas it is a straight forward high speed driving test followed by a second gear bump test.

L. Ray Buckendale, Timken-Detroit Axle Co., said it is difficult for Timken with its large heavy equipment to make small model tests the way passenger car people do. However, he believes that the work being done by the passenger car manufacturers can be correlated with the problems of the heavy duty field.

Mr. Keyser pointed out that CRC has not attempted to set specific standards for equipment manufacturers but has simply offered a test procedure.

Mr. Willey felt that the 80 mph test cutting off ignition,

throwing out clutch, letting motor stop, coasting to 65 mph, and then suddenly dropping in the clutch is much too severe.

TRANSPORTATION AND MAINTENANCE SESSIONS

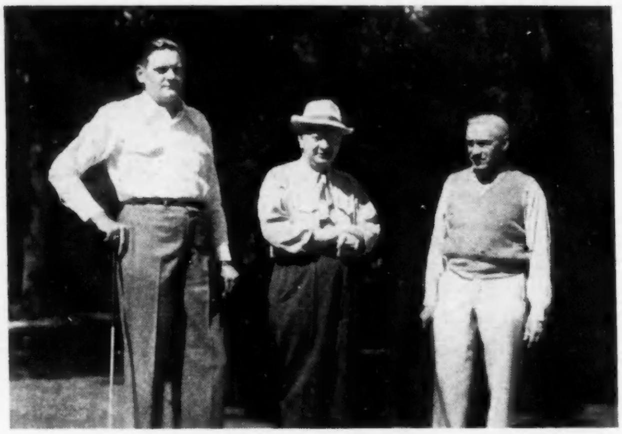
Chairmen

J. W. Lord — **E. N. Hatch**

Deviating from strictly engineering considerations, the Transportation & Maintenance sessions explored the psychological aspects of driver selection and training, and the economic background of planning and equipping garages for motor vehicle fleets. Rising labor costs, both for drivers and repair mechanics, focussed attention of engineers on these problems.

Which Driver for the Job? – AMOS E. NEYHART, Pennsylvania State College

BASED upon the assumption that initial selection of truck and bus drivers is the first element in any effective program of developing safe and efficient employees, vehicle fleet management was offered 16 procedures for finding potential drivers.



Fred Parker, R. T. Henderson, and Ralph Busse made a threesome

R. S. Huxtable, chairman of golf committee, with S. C. Merrill, F. C. Barrows, and R. G. Wingerter

Urging the adoption of modern tools for employee selection, the author emphasized the importance of job analysis and specification as the preliminary step to increase economies of fleet operation. Scientific approaches, such as are used by airline management and other large industries, were recommended.

Other procedures and materials offered for competent selection of drivers included an application blank which was suggested in some detail; a careful and unhurried interview; verification of selected references; physical examinations; intelligence tests to check for mental characteristics of the applicant; personality inventory; check on vocational interest; an attitude test; traffic and driving knowledge tests; and driving skill and psychological tests, besides the usual check on police and state drivers' records.

Because the driver is always a representative of the company, and good will can be created or destroyed by the personality and habits of the prospective employee, the author stressed the importance of a careful training procedure. Furthermore, he pointed out, the attitude of the driver and his driving habits will have an important bearing on the economy of the fleet's operation.

The efficient fleet management will choose young men with little experience rather than rely on men with a great deal of experience. Many bad driving habits cannot easily be changed, he pointed out, whereas with proper training a carefully selected employee will become a valuable asset to a fleet.

Inasmuch as habits account for some 90% of human behavior, it was pointed out that control should be maintained over driving habits and attitudes during the training period.

The author cited examples of decreased insurance costs due to bettering safety records of fleets. This has, he pointed out, a definite bearing on lowered maintenance costs of the operations as well as actual decrease in liability insurance premium payments.

DISCUSSION

Profitable operation of a motor vehicle fleet requires rigid adherence to careful selection and training of drivers, in the opinion of D. M. Goodwillie, Willett Co. "We have shown clearly that our use of Prof. Neyhart's methods have reduced accidents and have speeded up our operations." R. J. Olson, Fred Olson & Son Motor Service Co., agreed with Mr. Goodwillie that one of the hazards is that a man with a perfect record may suddenly find himself in trouble with accidents.

The author explained that the urge of doing a good job was present in the makeup of all men, and that often a driver can be "rehabilitated" with words of encouragement and more special training if he appears to be slipping.

Both discussers agreed that it is fairly easy to obtain cooperation from union leaders in a driver selection and training program. Despite exceptions, Mr. Olson said, union leaders cooperate best if the employer has detailed records on the behavior of the drivers.

Driving tests devices were demonstrated and skill-developing exercises were conducted by Prof. Neyhart following the presentation of his paper.

Shop Layout and Equipment for a Large Fleet – ELLIS W. TEMPLIN, Los Angeles Department of Water and Power.

TAILORING new maintenance shops for a large fleet of assorted vehicles with view of reducing maintenance costs and assuring improved reliability of labor and fleet efficiency is a task that requires careful analysis of the vehicles themselves and choice and location of shop equipment.

The 1206 vehicles to be serviced will require an outlay of $900,000 which includes the built-in features specified. In view of estimated labor costs increasing 17¢ per hr over 1946-47 by the fiscal year 1950-51, careful consideration was given to increasing working efficiency in the new facilities.

Analysis of efficiencies of hoists versus pits, overhead cranes versus none, clear and consolidated working space versus scattered and interrupted space, nearby cleaning facilities, good heat, light, and ventilation, the use of chassis dynamometer versus road testing, and other considerations led to decisions which, it has been estimated, will improve overall working efficiency of the new shop by at least 32% and possibly 50% or more.

DISCUSSION

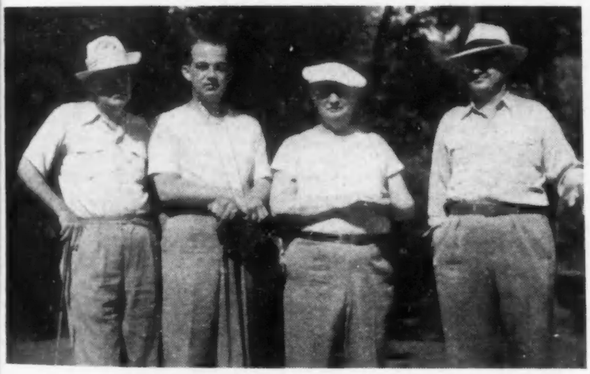
Frank Ward, Surface Transportation Co., New York, urged that the Society initiate "a broad and comprehensive study" of the problem of shop layout and equipment. Thus, he said, other fleet operators would have at hand information to guide them in the rehabilitation and enlargement of fleet servicing facilities.

Public utility fleet maintenance cannot afford periodic equipment inspections of 1000 miles or 30 days, according to Harry O. Mathews. Too much of the equipment runs too few miles a year to justify the expense of such inspections in view of the high – and increasing – cost of labor.

Inspection sheets tend to become loaded with additional points, and once these instructions are printed there is a tendency to add, rather than eliminate, items. As a result, simple routine inspections become major projects. "I don't know what the optimum mileage or the period for the utility business is," he said, "but we must get something settled even if we start out 'by guess and by golly.' "

It is often more practicable to leave a truck on location, and bring men and materials to it rather than to operate a heavy vehicle to and from the work, he said.

Charles Hudson, Tennessee Valley Authority, disclosed that the four basic points in planning garages were designing the building to handle the task instead of compromising with a makeshift layout, maximum utilization of the building itself and its maneuvering areas, spotting work benches alongside work spaces, and adopting a color scheme to lessen eyestrain.



E. A. Wales, S. R. Zimmerman, Jr., H. C. Dishman, and H. S. Eberhart

Another threesome was composed of F. Leister, R. F. Steeneck, and H. O. Johnson

A good deal of his work is farmed out, his experience being that considerable savings could be effected thus particularly in battery and tire repairs, crankshaft grinding, and large engine bearing work.

PASSENGER CAR AND BODY SESSIONS

Chairmen

S. W. Sparrow — **T. L. Hibbard** — **H. T. Woolson**

European *versus* American automobile design, a progress report on rubber suspension for cars, and an analysis of fuel and engine relationship of the future, stimulated some of the most vigorous discussions during the Summer Meeting. Consensus was that considerable progress in thinking was made, despite lack of agreement on many of the details cited by authors and discussed freely by the audiences. The Passenger Car Activity also participated in planning a joint session with the Truck & Bus Activity in reporting German automotive developments, as reported at the end of this article.

Potentialities of the New Fuels in the Design of Passenger Car Engines – EARL BARTHOLOMEW, Ethyl Corp.

PRESENTLY available and anticipated motor fuels offer attractive possibilities of increased fuel economy through supercharging or greater compression ratios and increased power output per cubic inch displacement. With the virtues of high octane number fuels, however, arise formidable problems for the engine designer, Mr. Bartholomew demonstrated.

Improved fuel antiknock value for Otto cycle engines provide potentialities of increased compression ratio and higher volumetric efficiency. To understand these potentialities of different fuel types, the engine designer has to contend with octane numbers and experimental tests of representative fuels. The fuel industry must adjust fuel composition to engine design trends. Since building and testing of experimental engines for selection of the proper manifold pressure and compression ratio combination from the wide latitude available with new fuels is prohibitively expensive, the speaker outlined a simple method for estimating the overall percentage increase in performance and economy.

High compression engines requiring 90 to 95 octane fuels develop explosion pressures in the order of 1000 psi at a compression ratio of 8.5, as compared to about 600 psi at a 6.0 compression ratio. Greater structural rigidity is obviously required and short engines of the V and opposed design types appear to have an advantage over the in-line engine. Combustion chamber redesign will be required to provide satisfactory flow contour into the valve compartment and thus prevent loss of volumetric efficiency. Higher pressures will cause temperatures approaching the fuel's self-ignition temperature, Mr. Bartholomew reported, and any hot spot may initiate combustion before regular ignition to create "wild pings" or piston burning. Since high antiknock fuels are temperature-sensitive, most efficient utilization of these fuels requires engine design providing the mildest practicable conditions for fuel combustion.

Peculiar to a supercharged engine – with higher manifold pressures – is the increased energy liberation per unit volume of engine displacement and consequent temperature increase of all parts exposed to the burning mixture or the exhaust products. Both spark plugs and valve steels require further studies for performance at high temperatures. Other factors to contend with in the supercharged engine are carburetion, intercooling, and blower design and location.

Potential improvement in fuel economy is particularly desirable, the speaker concluded, in view of the uncertain extent of our petroleum reserves and a possible gasoline price increase due to added taxes and greater costs in oil production from marginal sources.

DISCUSSION

Forecasting of fuels with octane numbers of 86 for 1950 by straight line extrapolation of ASTM values did not

Another old-timer gets close scrutiny from experts

seem reasonable to D. P. Barnard, Standard Oil Co. (Ind.). He contended that refiners are only too well aware of rapid increase in cost in producing octane numbers much over 80 and that Mr. Bartholomew's projection of such high values was unsound.

Effectively dispelling any doubts occasioned by Mr. Barnard's comment, R. W. Goodale, Standard Oil Co. (Calif.), advised that the octane ratings predicted for 1950 have already been achieved on the west coast. Although the octane number can be increased by simply increasing the lead content of the fuel, the new problems introduced stimulate thinking as to whether this is the most economical method of obtaining increased octane ratings.

In one case cited by Mr. Goodale, an orange grower using high octane fuel for a stationary engine experienced such high rate of deposit on valves and in the combustion chamber that the engine was severely damaged. Therefore, if high octane is to be obtained through conventional methods, it must involve either a change in engine design, or improved techniques in dealing with tetraethyl lead.

Considered impractical by Mr. Barnard was desirability of high compression ratios of eight or nine for small engines. It defeats its own purpose, he felt, as there is insufficient area available for the inevitable combustion chamber deposits.

No advantage could be seen by Mr. Barnard in supercharging over normal aspiration in a large engine with automatic transmission. By keeping the rpm down, the automatic transmission eliminates to a large extent pumping and friction losses much the same as supercharging.

Volatility is an important consideration in antiknock quality of a fuel, J. B. Hill, Sun Oil Co., observed. It is a fact that antiknock drops off with an increase in boiling point. A great advantage of catalytic cracking, he felt, was the least amount of loss in octane numbers by this method as compared to any other. Catalytic cracking should appear attractive to refiners in that it does not necessitate a drop in yield to get the high octane numbers.

An Independent Four-Wheel Suspension – With Rubber Torsion Springs – A. S. KROTZ, R. C. AUSTIN and L. C. LINDBLOM, B. F. Goodrich Co.

(Presented by Mr. Krotz)

RUBBER torsion springs make possible a new approach to the solution of many suspension problems in designing light weight passenger cars. Objections to conventional suspensions eliminated by this design are serious changes in stability, appearance handicap, and various mechanical disadvantages.

The rubber torsion or Torsilastic spring is comprised of a central shaft and an outer tube with a rubber cylinder bonded between them. The spring performs its own locating function and needs no bearings as it resists tilting, axial, and radial deflection about its own axis. It needs no lubrication; cannot rattle or squeak; and eliminates the dry friction effect of leaf springs.

Described was an experimental car built with an independent 4-wheel, Torsilastic spring suspension. The front suspension has a desirable understeering effect without losing tire cornering power and increasing tire wear, as is true with most suspensions. Design geometry is such that front wheel disturbance is reduced and balance during braking, between front and rear load, is maintained.

Hydraulic steering used satisfies the two requirements of reliability and maintenance of wheel alignment. The wheel elements and support arm are arranged to cause no steering error due to elastic movement of the arm, and the hydraulic system damps harmonic impulses from the wheel.

Incorporated in the design was a constant level device to hold the chassis at designed level regardless of load changes. The system is hydraulic and consists of a single source of hydraulic pressure and a small working cylinder at each of the four suspension springs which rotates the spring shaft to maintain the designed height of the chassis.

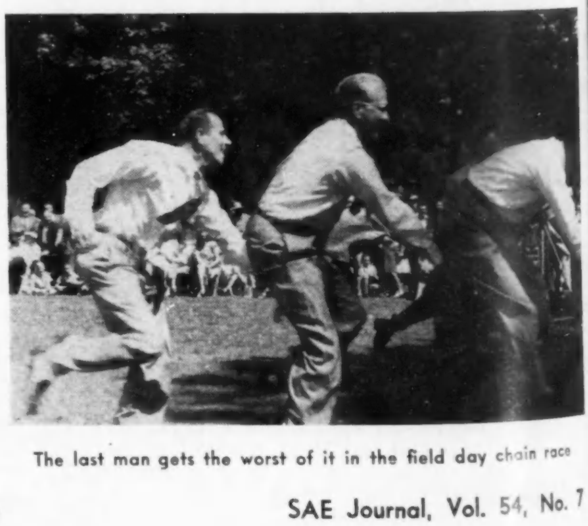
Noise level and harshness are reduced since the Torsilastic spring forms its own bearings and completely interrupts the metallic path from wheel to chassis. Flexible wheel mounting to further reduce noise and harshness is obtained with long and slender front springs, raising the unsprung mass natural frequency above wheel hop frequencies, and with relatively short and fat rear springs which provide softer transverse and longitudinal rear wheel deflection.

DISCUSSION

Development of the independent 4-wheel suspension using rubber suspension springs by Mr. Krotz and his colleagues was considered by R. P. Lewis, Spicer Mfg. Co., to be a marked advancement in the direction of improved riding comfort. One of the advantages of this system is the low unsprung weight, a fundamental "must" for good riding quality. The unsprung weight of the Goodrich car, he indicated, is 35% less than with the conventional suspension system.

One of its disadvantages is the increased deflection of the gears. Being more flexible than the conventional axle, this design does not provide sufficient rigidity to prevent excessive deflections caused by the gear loads. This can be accomplished eventually, Mr. Lewis felt, by careful analysis of deflection tests and by providing satisfactory ribs.

The chief virtue of rubber, declared R. W. Brown, Firestone Tire & Rubber Co., is its ability to carry more energy per lb than any other elastic material. With a suspension of this type, he added, it is necessary to utilize the high



The last man gets the worst of it in the field day chain race

elastic properties of rubber as the tri-plane flexibility of the wheels creates three different sets of secondary vibrations that rubber will absorb.

Rubber technology still has many problems to solve, admitted E. E. Blaurock, U. S. Rubber Co., to improve the physical properties of rubber. One of the problems is the stiffening of the modulus at low temperatures tending to reduce its elasticity. Creep is another objectionable characteristic which should be reduced.

Wheel geometry compelling the wheels to oscillate in all three planes enhances stability by raising the roll centers and keeping the wheels nearly square with the road under cornering conditions, P. H. Pretz, Chrysler Corp., reported. This should also improve tire wear which is accomplished by camber change. He felt that the hydraulic steering is justified if it eliminates the steering wheel disturbance of a mechanical linkage.

Endorsed by D. G. Roos, Willys-Overland Motors, Inc., was the liberty taken by Mr. Krotz in the suspension geometry. He believed that the design can be improved, however, by elastically mounting the differential on the chassis to allow it to breathe and to absorb components of road shocks. Clear thinking and sound engineering of suspensions of this nature can be attained only at such time that the overall problem is broken down into its two basic elements, namely:

1. Suspension and geometry.
2. Relationship of metal to rubber.

Mr. Roos warned against confusing the two factors in studies of this nature.

The Performance of European Economy Cars – L. POMEROY, The Motor Magazine, London

INFERIOR performance and a much more highly stressed engine of the European passenger car – as compared to its American counterpart – are largely a function of economic influences. But new design considerations, Mr. Pomeroy advised, may make it possible for the small European car to challenge the larger U. S. types in speed and durability, and at the same time maintain or even increase the lead held in economy of fuel consumption.

Lack of purchasing power and relatively high production costs have kept European cars down to 1,000 lb, with the accompanying sacrifices of limited passenger space and smaller engines running at higher rpm. Comparing the relative durability of a 72 cu in. British engine and a 220 cu in. American engine, Mr. Pomeroy demonstrated that, at 60 mph, the gross output of the British engine is 54.5 hp per 100 cu in. displacement and only 29.5 hp for the American engine per 100 cu in. In other words, the smaller engine works nearly twice as hard.

Aerodynamic design of European body shapes can achieve a 50% reduction in drag and looms as one of the greatest improvements to the small car. Some of the advantages, for example, are a theoretical

Four old cars revive many memories as they parade

These non-automotive machines were worked hard and long

gain of 26% in maximum speed with no change in engine size or maximum horsepower and no sacrifice in reduced passenger space or greatly increased overall length.

Reduced drag, from the practical viewpoint, is even more important an influence on fuel consumption and length of life. If total resistance is halved, consumption will be improved from 20.7 to 34 mpg, a gain of 65% as compared with only a 31% improvement possible with the larger engine. The effect of drag reduction on the abovementioned gross horsepower factor, indicative of relative durability, is to reduce the ratio of the small to the large engine factor from 2.3:1 to 1.53:1. It is, therefore, logical to assume that potentialities of increasing the life of the European car to approach that of the larger American car are great.

With the glowing prospects of performance and durability improvements within grasp, European automotive engineers still have to solve several problems associated with the aerodynamic body. Most important is the maintenance of lateral stability, made difficult by a forward shift of the center of wind pressure. Particularly troublesome on English roads is the effect of low drag bodies on cornering and steering.

The Relationship of Lines Vs. Shape in M.P.G. – ALEX TAUB, Matam Corp.

BOTH attractiveness and function can be achieved in passenger car design, it has been demonstrated with facts and figures, provided designers recognize the fact that shape, not lines, is the salient criterion in the pursuit of an improved "miles-per-gallon" factor.

To effectively analyze gas mileage delivery, it is necessary to examine the three consumers of power, namely: rolling resistance, weight, and wind resistance.

Rolling resistance is reduced, road tests have proved, by the square of the increase in tire pressure. Maximum air pressure in tires is particularly inviting for greater fuel economy, increased tire life, and facile steering.

Weight is a triple threat element, effecting drag, performance, and cost. France conducted exhaustive studies on an aluminum car to conserve coal. It was found that 6 aluminum cars could be produced with 1½ tons of coal rather than just one prewar steel car. Aluminum cars, the French concluded, can be built within 15 to 18% above the cost of a steel car.

In studying the third factor, wind resistance, the importance of thinking in terms of shape rather than lines becomes obvious. If it is borne in mind that work is being done in shoveling air much the same as with snow, then an air plow design of the front end to force the air out of the way appears to be undesirable. The body should be designed to give a uniform deflection of air over and under the car rather than create eddies that are power parasites. The messy harmonica type grille and bumper design of present-day cars are hardly suitable for providing reasonable air stream flow in either direction.

Elliptical shape given to the body and fenders, not unlike air foil applications, offers the least wind resistance and is thus most efficient from a fuel consumption standpoint. Applying these principles to American passenger car design, Mr. Taub predicted, would result in an average gain of 30% in fuel consumption.

Although we lead the world in productivity of automobiles, he concluded, it is high time that we take a cue from the ingenuity in engineering thinking behind European practice.

Prof. Amos Neyhart brought this car to test driver skill in a demonstration following his paper

DISCUSSION

Subject of greatest controversy in the Passenger Car Sessions was European versus American design as presented by Messrs. Pomeroy and Taub. The speakers pointed out the potential economies available in streamlining and weight reduction of the car. Mr. Pomeroy created a stir with the revelation that American cars are capable of maximum speeds of only 80 to 90 mph according to European road tests.

This veritable bombshell thrown out to the interested engineers was given a mixed reception. One school of thought felt that the speaker's plea for a lighter streamlined car giving high values of mpg was definitely out of order for the American market. While economy is the cardinal consideration in the European car, the consumer in this country is primarily after driving comfort and safety, which is sacrificed to some extent if fuel economy becomes the designer's first criterion.

On the other hand, consensus of the other group was that the authors made a valuable contribution in that they stimulated thinking in the right direction. For example, Mr. Taub declared that the messy grill and splashy chrome on our cars are not only unnecessary ornaments, but tend to work against, rather than aid the effort toward streamlining. While this group did not agree with Mr. Taub's and Mr. Pomeroy's proposals *en toto,* they did feel that our automobiles were in need of radical changes and that application of rational engineering in body streamlining was a step in the proper direction.

Rubber suspension springs discussed by Mr. Krotz and demonstrated in the Goodrich experimental car created more than passing interest. Although rubber springs are not new to the truck and bus field, their use in passenger cars is still confined to the developmental area. But the obvious advantages of an independent four-wheel suspension using rubber suspension springs over conventional suspensions makes it mandatory that the chassis engineer examine rubber suspension.

Its virtues, which all add up to greater riding comfort, are greater stability, noise reduction, improved steering, and mechanical simplicity. All is not rosy, however, since there are still physical properties of rubber to contend with such as stiffening of the modulus at sub-freezing temperatures and the creep factor.

Passenger car design is dictated by its market, declared W. B. Stout, consulting engineer. In Europe, the greatest design influence is exerted by the tax assessor with the result that economy is the most important single factor. A small car is low in cost, gives a relatively high mileage return for fuel consumed, and logically meets with widest consumer acceptance. All other considerations are secondary.

In this country, however, Mr. Stout pointed out, the public is not concerned with mpg. Comfort and safety are the designer's criteria. In effect, American cars are sold from the inside out. There is no doubt that streamlining is invaluable in so far as it reduces wind noises, gives wider seats, results in better vision, and in general adds to the luxury of motoring. But this country will not accept a small car, he felt, if passenger safety and comfort are to be sacrificed for economy.

Conceding that Mr. Stout's reasoning was correct, Mr. Taub countered that he was not trying to sell the industry on the small car for the American market. What he was attempting to prove was the value of an open mind. We can materially benefit from the engineering advancements of the Europeans and should not completely disregard their progressive automotive technology.

There is room for improvement in American passenger car design, he stated. Whereas truck design has reached the stage where each pound of vehicle will carry its own weight in payload, we still build a 3300 lb passenger car to carry 750 lb of live load. A car weighing between 1800 and 2250 lb is a practical possibility, he concluded, and should be the goal of industry in this country.

Design: Accidentally or On Purpose – R. E. BINGMAN, Designer

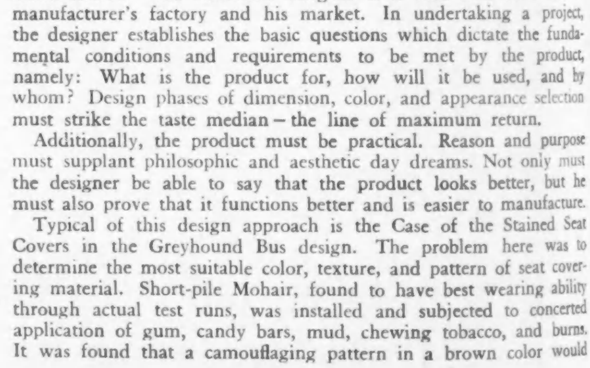
GOOD design is never accidental, but rather the culmination of rationally developed thought processes reflecting a never-ending search for clues to practicality and mass acceptance, Mr. Bingman contended. It should be the crystallizing of the public's desire at the exact moment they become aware of that desire.

An illustration of the force of habit pattern upon design acceptance was the compromise made in helicopter design with an egg-shaped air foil and seats directly behind a Plexiglass arc. The engineers, automobile drivers inbred with the habit pattern of having a hood in front of a moving vehicle, insisted upon the negligible protection of such projection which resulted in an incision of the egg-shape.

Scientific methods are applied to industrial design, the speaker demonstrated. The industrial designer is a vital link between the manufacturer's factory and his market. In undertaking a project, the designer establishes the basic questions which dictate the fundamental conditions and requirements to be met by the product, namely: What is the product for, how will it be used, and by whom? Design phases of dimension, color, and appearance selection must strike the taste median – the line of maximum return.

Additionally, the product must be practical. Reason and purpose must supplant philosophic and aesthetic day dreams. Not only must the designer be able to say that the product looks better, but he must also prove that it functions better and is easier to manufacture.

Typical of this design approach is the Case of the Stained Seat Covers in the Greyhound Bus design. The problem here was to determine the most suitable color, texture, and pattern of seat covering material. Short-pile Mohair, found to have best wearing ability through actual test runs, was installed and subjected to concerted application of gum, candy bars, mud, chewing tobacco, and burns. It was found that a camouflaging pattern in a brown color would



Shoe fitting kept this group of women busy during the Field day

absorb, in color at least, most of these soiling agents. A semi-regular pattern, an idea stolen from the frog, made stains even less visible.

Only through the industrial designer's and engineer's realization of each other's problems and potentialities, Mr. Bingman summarized, will real progress be made in mass produced commodities.

TRUCK AND BUS SESSIONS

Chairmen

B. W. Keese — **L. H. Smith**

Bus and truck operators restated their demands for equipment engineered more closely to operation requirements at the Summer Meeting's Truck and Bus sessions, but called for low priced units within the more severe specifications. Their demands, the discussions disclosed, had engineering merit, but designers were hard pressed to think of how the utopian vehicles could be built in the face of rising manufacturing costs. Despite no sweeping conclusions, agreement was reached on many a detail which may be counted upon to improve the operators' position as development proceeds.

The Motor Truck's Job Along the Eastern Seaboard – T. V. RODGERS, American Trucking Associations, Inc.

WITH operating costs steadily rising and hauling rates remaining fairly stable, the trucking industry – largely a public utility – is vehement in its demands for a greatly improved purposeful vehicle, reduced in cost and simple to maintain, as a bulwark against rapidly dwindling profits.

Too often commercial vehicle thinking is predicated upon passenger car operation. How obviously unsound is this concept, Mr. Rodgers demonstrated by comparing the passenger car's average life of 100,000 miles and once-a-year check-up with the average truck service of 10,000 miles per month and a lubrication job every 1,000 miles. A truck out of service ten times per month plus another day for a complete check-up represents a goodly loss in potential revenue. The truck owner wants as little maintenance work as possible during productive hours.

As an example of design from the operator's viewpoint, Mr. Rodgers described an ideal trailer as one with only three lubricating points and some method for determining the amount of brake lining remaining without removing the wheels. The three lubrication points should be the wheel bearings and the fifth wheel plate. To use brake lining as a guide for maintenance, a peep hole or gage should be provided to determine lining thickness without removing the wheel, and while the vehicle is under load.

Other troublesome truck features challenging the designer's ingenuity include truck floors which need considerable strengthening to take all types of freight being hauled and concentrated lift truck loads of 6,000 lb on two wheels. As regards the driver, power brakes – as the name implies – should require very little of his effort in braking operations to prevent undue fatigue from frequent stops. Dependence upon heat leaking through the floorboard cracks to heat the driver's cab is definitely not in the interests of safety. Two-way radio, larger tires, and refrigerated food carriers are a few of many developments operators are looking forward to in commercial vehicles.

Manufacturers' acceptance of the trucker's conception of a truck as a piece of machinery to operate rather than to maintain, the speaker concluded, will make for a vehicle more suited to the operator's needs.

DISCUSSION

Several design engineers pointed out that although they were conscious of the increasing costs of maintenance, the service-free vehicle had not been developed. On the point of reducing lubrication points raised by Mr. Rodgers, he was assured that work is being done to simplify the task of the operator in this respect. Another discusser warned the audience that any such design would inevitably raise the original cost of the vehicle.

E. N. Hatch, New York Transit System, reported that considerable work is being done by the bearing industry to increase bearing life. Considering the cost of labor in bearing replacements, doubling the life of engine bearings would be a boon to all fleet operators.

Motor Carriers' Viewpoints on Equipment Design – H. F. CHADDICK, American Transportation Co.

(Presented by Mark E. Ferrari)

TRUCK design is in need of wide improvements leading to more efficient and safer operation as well as less costly maintenance, advised Mr. Chaddick in representing the viewpoint of central states carriers. To achieve these aims, he advocated uniformity of construction, suitable equipment, and added features to aid in maintenance.

Uniformity of state weight and length laws now makes possible uniformity in power unit and trailer construction. Variety of dash arrangements, transmission shifting patterns, and differences in clutch and brake pedal pressures make the driver's job more difficult. These items can be standardized in the various truck makes and models without hindering the designer's ingenuity.

In addition to a uniform instrument arrangement, the dash-board should have a crankcase oil temperature gage. Oil serves as much as a bearing coolant as it does a lubricant and the oil pressure gage is no indication of temperature. Cooling oil has, on occasions, reached temperatures at which the bearings could no longer be kept below their plastic state and failed. Too low an oil temperature in winter promotes water sludge and other difficulties detrimental to engine operation.

Maintenance could be greatly speeded up by better instrumentation and built-in attachments to utilize these instruments. For example, to make a simple fuel pump pressure test, the fuel line must be disconnected, fittings and adaptors inserted to connect the pressure gage into the line, the engine started, pressure read, fittings dismantled, and the lines reconnected. This job, which takes 20 to 30 min at best, could be reduced to a 5-min operation if a tee were permanently installed on the pressure side of the pump for connection of a fuel pressure gage.

Other similar devices recommended by Mr. Chaddick are: fly wheel markings to give the mechanic some idea of the extent of error in spark timing; alignment marks on front and rear axles, and dial indicator perches to determine side and end play in differential rear bearings. Test equipment for preventive maintenance should not be built to make necessary the removal of vehicle parts for bench testing as a complete diagnosis of the condition and operation of the unit is not possible unless it is tested on the vehicle.

If all truck and tractor units were properly set up for inspection purposes, the speaker concluded, a complete instrument inspection and necessary corrective adjustments could be made in a few hours instead of the usual 8 to 12 hr now required.

Truck Design for Intercity Service in the Western States – J. L. S. SNEAD, JR., Consolidated Freightways, Inc.

(Presented by Frank Jardine)

WESTERN fleet operators are particularly desirous of lighter weight vehicles with standardized equipment and interchangeable parts as well as sturdy construction and simplicity of operation, because of the long distances and long, steep grades, Mr. Snead reported.

State weight restrictions place a high premium on reduction of vehicle weight to haul increased loads. Reduction of unladen vehicle weight using alloy and heat-treated steel, aluminum, and other light metals, already achieved to some extent, should be further pursued to meet rising costs of labor and material. Wider use of light metals for front axles, differential carriers, disc wheels, and many other parts seems practicable.

Reduction in unladen weight further accentuates serious braking problems resulting from laden and unladen weight differential. For example, brakes designed for a 72,000 lb gross load give severe action and make for extremely difficult control in emergency stops for the unladen condition. Braking problems are further aggravated by the time lag between the brake pedal movement and contact between the shoes and drum.

Standardization and interchangeability are needed because of lack of parts stocks, adequately equipped shops, and trained mechanics. Similar parts on truck and trailer axles should be interchangeable.

Design simplicity can be beneficial to both operation and maintenance. Any arrangement requiring the driver's special attention or handling is a source of constant trouble. Maintenance, to be simple and thus less costly, should permit: easy accessibility, positive, accurate adjustments with a minimum of judgment, easy removal of units, and a minimum number of pieces. Sturdiness of items such as heat indicators, speedometers, and oil gages is a must in withstanding steady vibrations over a long period of time. Sheet metal parts should be designed to last the life of the vehicle and wiring should be protected from grease and permanently mounted to prevent wearing through.

Truck Design from the Viewpoint of the Operator Engaged in Local Trucking and Delivery Service – W. D. BIXBY, R. M. WERNER, and H. E. EARL, United Parcel Service of America, Inc.

(Presented by Mr. Bixby)

PRODUCTION of vehicles fully equipped for most economical and effective service can be attained only through design based upon requirements of driver comfort and job satisfaction, efficiency, safety, and proper maintenance, the authors demonstrated.

The driver's job can be greatly simplified by items such as collapsible side doors, as used on buses, eliminating the risk of a half-opened hinged door striking another vehicle or obstruction. Local trucking expends much of the drivers' energy in maneuvering in and out of tight spots and provisions to reduce steering effort are well worth while. Five-speed transmission in local service is unnecessary; somewhat different gear ratios than used in present type four-speed transmissions would be more suited to city delivery service.

As for maintenance, reduced frequency of daily service routines of filling gasoline tanks, radiators, and crankcases would well justify a considerable initial investment. Puncture-sealing tubes and proper size tires are great dollar savers for the operator and should be standard equipment. Still another problem, sludge deposits in the crankcase – prevalent in local service due to difficulty of maintaining normal temperatures – can be kept to a minimum by sufficient crankcase ventilation.

Equally trying is the mechanic's ever-present nemesis – inaccessibility. A few examples cited by the authors are: hard-to-replace fan belts, impossibility of operating a valve seat refacer on the far cylinders, inability to adjust and replace valves, and inaccessible rear core plugs. Manufacturers were taken to task on the unnecessarily shortened life of sheet metal parts due to failure to apply a rust inhibiting primer before assembly.

Most revealing in the maintenance discussion was the presentation of the road failure analysis of a large fleet based on 4,500,000 local service miles. Over 39% of the 1,815 failures experienced were attributed to the electrical system, by far the worst offender.

Inter-City Bus Design from the Operators' Viewpoint – T. L. JAMES, Burlington Transportation Co.

INTER-CITY bus design should include improvements contributing to longer life of all units and decreased operational costs to satisfy transcontinental hauling requirements. Considered desirable by Mr. James is a bus costing no more than $20,000, weighing 19,000 lb, capable of running 2,000,000 miles, and including some special equipment.

Of prime importance is the need for an engine with sufficient power to allow the bus to maintain its position in highway traffic. Present engines are inadequate for ascending long grades at higher altitudes, where a part of the horsepower is lost. At least a 50% increase in power is required. One solution to the problem is the Twin Coach Co. bus, now under construction, with two 180 hp engines. Ample horsepower can be produced by this scheme at lower engine speeds; thus contributing to longer engine life.

Another advantage of the two power units in a bus is the ability to continue on and bring in a bus from the point of road failure to the garage. Many dollars can be saved by such an installation, the speaker declared. The average cost per road failure to his company in 1945 was $115.45 and ran as high as $400.00 in some territories.

Second on the list of items desired is some type of automatic transmission, such as torque converters, to eliminate clutch and transmission as we know them now. An increase in overall length is desirable to give increased space between seats for greater passenger comfort.

Believed by operators to have an important place in bus operation is two-way radio. A central station is now being installed in Chicago with sufficient power to broadcast within a radius of 100 to 120 miles of the city. Mobile radio equipment has been placed in more than 100 buses and tests are to be conducted for a 6 month period to determine all possible uses and benefits of two-way radio.

Other improvements advocated by Mr. James covered: air conditioning equipment to cope with sustained heat of desert runs; under-the-floor baggage compartments loaded from the outside; an auxiliary heating unit for both warming the bus and heating the engine without the use of anti-freeze, and accessibility of accessories for a minimum of labor in servicing.

Objectives in Motor Coach Design for Urban Service – A. F. McDOUGALD, Capital Transit Co.

URBAN bus design should provide for passenger and driver safety, comfort, and convenience and permit the driver to hold his place in traffic and maintain a fast scheduled service. Desirable features advanced by Mr. McDougald will permit the transit industry to attract additional patronage and reduce maintenance for minimum out-of-service time.

Comfortable, safe, and efficient vehicle operation by the driver implies proper road and traffic visibility, standardization of controls on all makes, and proper facilities for handling fares and passengers. Ease of maneuverability in traffic can be attained by as short a turning radius as is possible: a maximum of 40 ft is recommended. The design of the front end should give the driver clear visibility over a horizontal arc of 180 deg. Passenger comfort demands an adequate automatic heating and ventilating system and comfortable and attractive seats.

Selection of a power plant for an urban transit coach necessitates consideration of general performance requirements. Improvements in design and construction advocated by the speaker were: blocks to permit excessive distortion and to permit use of precision bearings without line boring; improved pistons to avoid excessive head, skirt, and ring temperatures; piston rings designed to prevent excessive oil consumption and oil passage plugging, and valves and valve mechanism improved to reduce burning, warping, and sticking.

Engine cooling systems should be free from leaks and maintain a minimum engine operating temperature of 185 F. Continued improvement in fuel systems is necessary to provide more economical operation, better operation, and reduced maintenance. Oil pump screens should be designed for inspection and cleaning removal without removing the oil pan.

Among other equipment in need of modification is the service brake system. It should be capable of making uniform stops of a specified rate without discomfort to passengers, fatigue for drivers, excessive maintenance and tire wear, and harmful effect on other coach equipment. The power transmission for urban coaches should enable the driver to hold his place in traffic with a fully loaded vehicle, which implies rapid acceleration and grade climbing ability. Transmission should be fully automatic to relieve the driver of all unnecessary operations and provide a smoother ride for the passengers.

Maintenance can be greatly facilitated, Mr. McDougald pointed out, if all bus equipment is installed to permit the unit replacement system. Initial capital outlay may be high to attain some of these objectives, but will be worth while if improved quality permits a net saving through reduced operating and maintenance costs throughout the depreciated life of the vehicle.

DISCUSSION

Increase in engine power came in for the largest share of the discussion. Edwin C. Paige, Ethyl Corp., predicted that more powerful bus engines will be forthcoming, but he cautioned against an increase in engine and gear speeds as a means of attaining greater power.

He suggested a need for 2-speed governors, the first speed to be from 1800 to 2000 rpm and the second at the manufacturers' prescribed safe governed speed for gears, say 2500 rpm, as a means of greater mobility in traffic.

Mr. James said that the use of 2-speed governors has aided bus operation in his company.

E. W. Templin, Los Angeles Department of Water and Power, said that in using the SAE power formula to determine how much added power would be required to do the

kind of a load and speed job demanded by bus operators he found that 300 hp would do the job adequately. Applying his calculations to a typical 300 mile stretch of highway, he found that with a dual engine installation, the second engine would be needed for only one hour of the run.

E. N. Hatch, New York Transit System, said that one of the underpowering difficulties is that certain engines which are rated at, say, 150 hp by their manufacturers, actually develop only 80 hp which is a long way from the higher powers being discussed.

J. B. Fisher, Waukesha Motor Co., was high in his praise of the two papers given and said that the industry has had this problem of increased power for a long time and that many times the operator purchasing the bus and the bus manufacturer have demanded lower power units than the engine manufacturer knew was proper to do the job economically. He also urged development work on a special carburetor, especially to handle economically the important part-load operation which is a big factor in fuel economy.

E. B. Mansfield, Firestone Tire & Rubber Co., added his plea for proper tire equipment, pointing out that adequate tire size results in overall operating economy and reduces safety hazards.

Virgil E. Weiss, Standard Oil Co. (Calif.), stressed the need for auxiliary heating for the long steep grades of the west, also for better cooling capacity in the desert countries because different kinds of water used in refilling produces scale. Oil temperatures are also affected. R. Wayne Goodale, of the same company, asked about an auxiliary starting fluid as an aid to hard starting in the morning for buses that stand out all night. He also asked whether a two-range supercharger would help high altitude operation and whether a variable pitch fan would aid cooling.

Mr. McDougald said that in the east the problem is not so much one of hard starting in the morning as it is keeping cooling and heating systems from freezing overnight.

Mr. James said that his company has found variable pitch fans to be satisfactory. When the engine is cold fan blades are flat, thus conserving starting and warm up power. Also the flat blades are used coming down long mountain grades.

MATERIALS SESSIONS

Chairmen

W. J. McCortney — **R. W. Roush**

Progress was reported in the understanding of the nature of synthetic plastics and in metallic alloys and the fabrication of aluminum at two materials sessions during the Summer Meeting in four papers and the discussions which followed. Simplified design practice was predicted as a result of current work on the classification of rubbery materials and development of hardenability of steels as a design criterion. New techniques in the fabrication of aluminum pointed a way to improved designs.

Again it was demonstrated at an SAE Meeting that basic elements in engineering progress are a joint function of the metallurgist or materials specialist, the designer and production expert.

Classification of Rubber and Rubber Compounds – G. H. SWART, General Tire & Rubber Co.

AUTOMOTIVE engineers and rubber technologists face the challenge of expanding coordinated research to determine the fundamentals of resilience, modulus and elastic flow, and temperature characteristics of rubber and rubber-like materials. Work by these two groups within the SAE and in cooperation with the ASTM has been praiseworthy, and has demonstrated the need of intensifying joint effort.

Once the fundamental physical properties of these materials are related mathematically a big step will have been achieved in working out these compositions as engineering materials. Then study should be undertaken of dynamic properties of these materials.

Little is now understood of the complex properties such as tear, abrasion, and wearing resistance.

Experts in this field of engineering research are encouraged by the current progress being made in the classification of rubbery materials. The work of the Joint SAE-ASTM committee was cited, and the military services were praised for their cooperation in the development of this knowledge which has led to a widening use by industry. Among the companies which have developed tables of classifications for this type of material are Chrysler, Ford, General Motors, and International Harvester Co.

Significant also is the interest of more and more consumers in the physical properties rather than in their composition. Better correlation of laboratory testing with field history is expected. Efforts are being made to obtain basic correlation to advance the knowledge of rubber and rubber-like compounds. The interest of the Rubber Manufacturers Association was counted upon to help advance common knowledge on the subject, the organization having already made valuable contributions.

Among important investigations by organized groups are staining of automotive finishes; electrical conductivity; high temperature aging; tear, impact, and flexing resistance, and high temperature oil aging of rubber and rubber-like materials.

DISCUSSION

Before present terminology in the field of plastics becomes frozen, consideration should be given to coining a generic word which can be used both as a noun and an adjective, in the opinion of James E. Hale, Firestone Tire & Rubber Co. He offered *elastroprene,* giving the word the physical characteristics associated with these materials, as well as a good chemical root. E. B. Neil, consulting engineer, offered for consideration *flexoprene* and *dynoprene.*

Roy Brown, also of Firestone, congratulated Mr. Swart for his paper and cited the need for more information of the physical properties of the new materials. He believed that designers need know little about the chemical constituents, but before these materials are used widely by engineers a great deal must be known of their physicals.

Automotive Glazing With Plastics – GEORGE B. WATKINS and JOSEPH D. RYAN, Libbey-Owens-Ford Glass Co.

(Presented by Mr. Watkins)

EXHAUSTIVE laboratory and field tests of automobiles glazed with plastic materials instead of plate glass indicate that considerably more development must be made in these synthetic materials before they can compete favorably with glass. Although the materials tested, which were Plexiglass, Lucite, and CR-39, were found to be considerably more resistant to impact than ordinary sheet or plate glass, and would thus appear to be safer than glass when installed in cars, the materials are subject to abrasion.

At the present state of transparent plastic development, the abrasive action of the windshield wiper on the windshield rules out its use in that part of the vehicle. Windshield heaters did not melt off ice and snow as rapidly as from laminated glass, due to the relatively low thermal conductivity of the plastic.

Because of the static caused by wiping the plastic dry after washing, dust and lint are picked up by the surface. It was impossible to attain a polish comparable with a glass windshield.

Because the plastics were not wet by water to the extent water wets and runs off a glass surface, little droplets of water markedly

hampered vision. The CR-39 appeared to be better than the other two transparent plastics tested. The tests showed that some of the plastics failed to pass the ASA Code Test for discoloration. Inasmuch as this is an extreme test, using the Uviarc lamp at 9 in. However, this test is held to be more severe than usage.

The research work disclosed that plastic glazing has a greater tendency to rattle as compared with glass. When the doorlight is partially lowered, for example, the greater resiliency of the plastic material produces a whipping action.

The fire hazard of the plastic materials is greater than with glass. Although the material does not propagate a flame, but burns in the presence of ignited gasoline.

The life of the plastics is considerably shorter than that of commercial plate glass in automobile glazing, because of the abrasion, warping, and scratching caused by service.

DISCUSSION

A note of caution was injected by T. C. Smith, American Telephone & Telegraph Co., in respect to the tendency of regulatory bodies to assume interim reports of engineering committees constituted standards, and then to freeze them in regulations. He urged every engineer to do what he could to offset this trend in government regulations.

Aluminum Brazing Development – L. P. SAUNDERS and P. S. ROGERS, Harrison Radiator Division, General Motors Corp.

(Presented by Mr. Saunders)

DEVELOPMENT of a process for brazing aluminum, which required redesign of brazing furnaces, made it possible to manufacture supercharger intercoolers with a test-to-destruction life of more than 100 times that of a soldered copper unit. Weight of the new unit was one half that of the copper intercooler.

Baffling problems encountered included determining the optimum heat in the brazing furnace, sludge formations, cleaning, and the tendency for unwanted materials to alloy with the aluminum which produced holes in the finished product.

Starting in 1938, the development program was at first based upon the company's experience in furnace brazing of copper and steel. A fundamental difference is the relatively close differential of the melting points of the parent aluminum and the aluminum brazing material. Current development of pyrometry and temperature control helped immensely in solving this problem.

Another difference was found to be that whereas the furnace atmosphere serves as a flux in chemically cleaning the metal being brazed, this atmosphere fails to remove aluminum oxide. A flux must be applied to aluminum to reduce the oxide during the brazing cycle. This requires cleaning.

Eventually a procedure and development of proper furnaces were achieved which resulted in the shipment of 5,489,104 lb of aluminum brazed parts during the war.

DISCUSSION

Fred M. Young, Young Radiator Co., told the audience that the entire industry has a debt of gratitude to the authors and their company in having been extremely cooperative during this development. He agreed with the authors, during the discussion, that the technique of aluminum brazing would go far to improve designs by reducing present limitations.

G. O. Hoagland, Aluminum Co. of America, was called upon to explain recent developments in the welding of aluminum and magnesium alloys. He described the development and use of arc welding in the presence of helium and argon atmosphere with a supply of the inert gas being supplied to the point of the weld with a tungsten tip. No flux is used, the weld is sounder, and defects are fewer than with the conventional methods. He indicated that relatively thick plates of aluminum can be welded successfully by the arc-inert gas method. Further reduction of cost was predicted by Mr. Hoagland as tips are designed with increased efficiency.

A Postwar View of Alloy Steels – ROBERT S. ARCHER, Climax Molybdenum Co.

DEVELOPMENT of the hardenability series of steel (H) recognizes that the first consideration in the selection of an alloy steel is that it must have a degree of hardenability suitable for the intended application. Based on SAE and AISI analyses, the H series guarantees a definite band of hardenability for each grade, thus replacing the chemical specifications formerly used.

A further advantage of the new series is that some of the heats from steel mills which would otherwise require special consideration can be handled in a routine manner because they comply with the original specifications.

Although it is recognized that theoretical bands calculated in this manner are too wide for many applications, it is not likely that many heats of a given grade will have all of the hardening elements on either the high side or the low side at the same time. To determine how narrow the hardenability band may be made without encountering an undue percentage of heats outside, the band will require extensive experience in the production of the H steels to accumulate adequate statistics.

Many factors affect the control of chemical composition and hardenability in steel making. It appears impossible to calculate the narrowest practicable hands by probability methods.

Merits of the NE "Triple alloy" steels in comparison with the old SAE grades have been questioned. The three alloying elements indicated by the term "triple alloy" are chromium, molybdenum and nickel. Substantially all of the molybdenum and nickel contained in scrap is recovered on re-melting by any process, and some of the chromium is recovered on re-melting, especially in the electric furnace process.

Presumably, vanadium was not included in these steels because it was scarce and because of the fact that it is not recovered in tonnage melting processes. Chromium-molybdenum-nickel steels are not new, since these elements were used in combination with each other for many years before the war.

The novelty about the NE triple alloy steels is that chromium, molybdenum and nickel are used in steels of moderate hardenability. The question is whether this practice is advantageous or otherwise in comparison with the use of a smaller number of alloy elements.

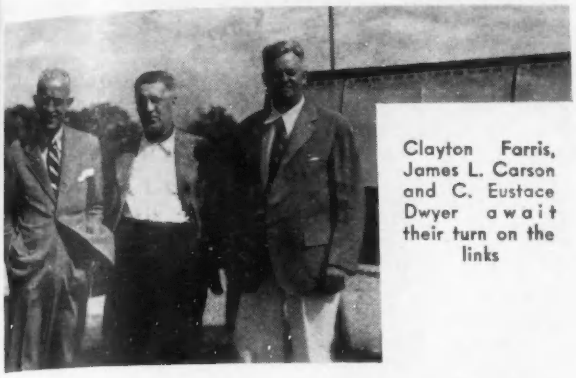
Satisfactory performance is a relative term. Machines could be built which would operate with a reasonable degree of satisfaction if made of materials substantially inferior to those available during the past twenty years. We would not be fully satisfied with such machines, and likewise we will not be satisfied with present machines if still more satisfactory performance can be achieved. The information gained during the past few years regarding the conditions necessary to insure maximum toughness in steel at a given hardness level suggests the possibility of improvements in design and performance based on consistently superior combinations of strength and toughness.

GERMAN AUTOMOTIVE DEVELOPMENTS SESSION

Dr. H. C. Dickinson, *Chairman*

In introducing the work of members of Technical Industrial Intelligence Committee teams, O. D. Treiber, Hercules Motor Corp., European representative and leader of the Automotive Team, related that these investigators gathered valuable data on German automotive developments under trying conditions that American industry may benefit by the developments and achievements of the enemy.

Greatest interest in every phase of the broad automotive industry centered about the design ingenuity and superlative craftsmanship displayed in military equipment. Lack



Clayton Farris, James L. Carson and C. Eustace Dwyer await their turn on the links

of radical configurations superior to our vehicles and engines was reported by the speakers, although detailed refinements are worthy of study.

Well received by automotive engineers was a display of captured German equipment which included various types of transmissions, bearings, clutches, and diesel engines. The following speakers were introduced by Past-President H. C. Dickinson:

Some Interesting Features of the German Motorcycle Industry's Developments – S. DU PONT, Indian Motorcycle Co.

NEW and interesting German motorcycle developments, described by Mr. du Pont in his survey of the industry, are the BMW racing motorcycle engine, military motorcycles with sidecar wheel drive, and the double-piston, two-stroke, supercharged racing engine.

The BMW engine, which topped the field in the Isle of Man International races in 1939, was a specially supercharged, 2-cylinder, opposed, 4-cycle engine with an overhead camshaft. The supercharger, driven direct by means of splines on the crankshaft front end, is interesting from a design viewpoint. It is a vane type having sliding vanes carried in a slotted dural rotor. The cylindrical rotor is mounted off center in a cylindrical magnesium housing and the vanes are not held by springs, nor do they actually contact the inside of the stationary housing. The supercharger pumps the carbureted mixture against a relief valve – which regulates the pressure – located ahead of the long pipes leading to the cylinder inlet port.

The second so-called novelty, the sidecar wheel drive, was used on a vehicle serving the same purpose as our Jeep. Specifications called for a three man crew, machine gun, and an equipment load of 995 lb to be carried at a top speed of 50 mph with a gas consumption of 30 mpg. The rear wheel drive design was elaborately adorned with bevel and spur gears and a torsion tube for springing of the sidecar wheel.

Information on the supercharged racing engine was obtained by Mr. du Pont from a Viennese technical journal published in 1943. The engine was liquid cooled and the supercharger, a reed valve piston type, was driven from an eccentric on the engine crankshaft. An independent crankshaft oiling system avoided the use of petroil mixture for fuel. The cylinders had no liners and were assumed to be cast iron, particularly since the ports and passages were integrally cored in the cylinder casting.

Aircooled Engines – A. M. MADLE, Briggs and Stratton Corp.

CONSIDERABLE research and development of small aircooled engines conducted by the Germans made valuable contributions to the art, although nothing revolutionary was discovered by Mr. Madle. Of the engine designs he observed, three in particular showed promise of postwar utility—had their development been further pursued.

For smallest constant speed applications where a moderate compression ratio is employed, cross flow scavenging with a deflector piston would have been employed. The "loop" scavenging design appeared most suitable for a somewhat higher engine compression ratio and larger engine on which more varied demands are made. "Loop" scavenging is a variation of contour scavenging in which the intake and exhaust ports are on the same side of the cylinder and the flow of the scavenging air – in order to produce satisfactory results – should follow the cylinder contour. This system gave a 15% increase in bmep and an equal improvement in economy above deflector piston methods.

The third system, dual piston uniflow with asymmetric intake valve and optional asymmetry of port timing, should be adoptable for engines required to meet extreme demands on power, economy, and elasticity. The uniflow system, in which the intake and exhaust are on opposite sides of the cylinder, was used by the Germans on motorcycle and automotive power plants. One of the dual pistons controls the transfer and the other the exhaust port. The asymmetrical timing permits supercharging whereby still higher values of utilization and economy can be achieved.

Tendency toward ever increasing power yield of fuel and displacement simultaneously gave rise to high thermal stresses and German engines and pistons, as a rule, were aluminum alloys of high silicon content. Since these alloys were claimed not to lend themselves to die casting, permanent mold casting became the generally employed production method.

Often used was a cast iron liner bonded to an aluminum cylinder with shrink fit screw threads to insure an intimate contact on a large area. Antifriction bearings were used as crankpin and main bearings, as is usual with crankcase compression and lubrication with fuel-oil mixture.

Summary Report on German Gasoline Engines – A. W. POPE, JR., Waukesha Motor Co.

IN spite of the similiarity of American and German engines in the 100 hp range, very interesting features such as superlative craftsmanship, detail refinement, and design ingenuity were observed by Mr. Pope in his survey of German gasoline engines.

One example is the BMW 6-cylinder, 120 cu in. sports model engine, a prewar model which was a refinement of the standard passenger car engine. It had push rod operated overhead valves and an output of 60 hp at 3750 rpm. A specially inclined valve cylinder head boosted the output to 80 hp at 4500 rpm and, further refined, the same engine delivered 150 hp at 6500 rpm. At a 1000 mile road race in Italy in 1940, this engine averaged 106.8 mph in a sports model body.

The most interesting trend in German engine design was the overhead valves mounted across the engine axis. Reasons given for this were to incline the valve to give room for a larger valve for high speed output, and to develop aircooled engines with cross flow cooling air. Push rod operated valves were favored by the Germans over the overhead camshafts. Considerable ingenuity was displayed in placing the push rod operated valves across the engine axis.

Gasoline injection replaced carburetion on the Maybach 70 hp engine, and increased its output to 800 hp, a 14% improvement. This amounted to 3.26 hp per sq in. of piston area at 2850 fpm piston speed, which is about 70% above average American passenger car output.

In closing, Mr. Pope described the operation of producer gas engines, an expedient resorted to for civilian travel because of gasoline fuel shortages. The charcoal or woodchip consumption rate is about 2 lb per bhp-hr, indicating that the fuel weighs 3 to 4 times that of gasoline fuel. Troublesome features of this engine are inconvenience of operation, draining of condensed tar products, and the chore of cleaning the filters.

Diesel Engines and Injection Equipment – R. C. MATHEWSON, American Bosch Co.

MOST impressive to Mr. Mathewson in his investigation of German diesel engines and injection equipment was their tendency toward gadgets in design, very few of which would be applicable directly to American production methods.

No striking developments were made in diesel injection equipment and gasoline injection nozzle progress closely paralleled that in this country. Most fuel systems on jet engines were of the common rail type using two or more rotary type positive displacement pumps to deliver fuel to the six or more burner tips. To insure even more even distribution to the individual combustion chambers, a cam-operated piston pump was developed running at 5000 rpm. The 12 cylinders were connected in pairs to common volume chambers. Each of the 6 common volume chambers was connected to one nozzle, ⅜ in. diameter x ⅜ in. long, a mark to aim at for future fuel injection nozzle design.

Unusual features found in one manufacturer's standard fuel injection pumps were a suction valve and the usual inlet port in the

cylinder wall which was claimed to give better filling and increased capacity. The nozzles had a flat seated valve instead of the usual angle seated type to permit easier servicing.

A novel 14-cyl barrel type gasoline injection pump for the BMW airplane engine used a three lobed disc cam rotating at 1/16 engine speed. The general design appeared good although the Germans experienced uneven distribution to the cylinders at high altitudes.

Another interesting development noted by the speaker was a governer for truck engines using the bypass fuel from the fuel pump as the governing medium. The bypass fuel acted on a spring-loaded piston which in turn was connected to the pump control rod. Regulation with this type of governor was not accurate – 10% from no load to full load – although the governor looked simple.

Worthy of mention is a cylinder head and liner of a German E boat diesel engine. It was machined from a solid one piece steel forging to which were welded sheet steel sections to form inlet, exhaust, and water passages.

German Automotive Development of Electrical Equipment – A. J. POOLE, Scintilla Magneto Division, Bendix Aviation Corp.

LITTLE outstanding development was observed in a survey of the German electrical equipment industry. Unlike their numerous designs and gadgetry in other phases of the automotive industry, the Germans froze several basic electrical equipment designs and electrical production never bottlenecked the war effort.

Spark plug production reached a peak of 1,000,000 per month for tanks and trucks and 200,000 per month for aircraft. Nothing novel was noted in production plugs except that some attention was given to plugs for high altitude and jet propulsion. A low tension spark plug was developed to overcome the difficulties with normal plugs. It was intended to enable the use of lower voltages, to lower fouling tendency, and make only one heat range necessary. However, it never reached the production stage.

Another interesting project under way, involved battery ignition for use on engines using heavy fuel oil. A spark duration of 30 deg was claimed which would operate successfully at 3000 rpm. Other experimental work conducted included high frequency, low tension, and electronic ignition systems, none of which can be considered advanced by our standards.

Tremendous quantities of magnetos, timers, generators, starters, and spark plugs were produced in 53 dispersal plants throughout Germany. Shortages in critical materials such as cobalt, copper, platinum, chrome, and rubber – considered indispensable in this country – forced the Germans to find adequate substitutes.

Particularly prevalent in all German plants visited, was the use of engine lathes and hand screw machines for operations for which we would have set up automatic machinery such as a Warner Swasey or Brown & Sharp. When questioned about the lack of modern production equipment, the Germans invariably replied that they had sufficient labor. Of course, they meant slave labor.

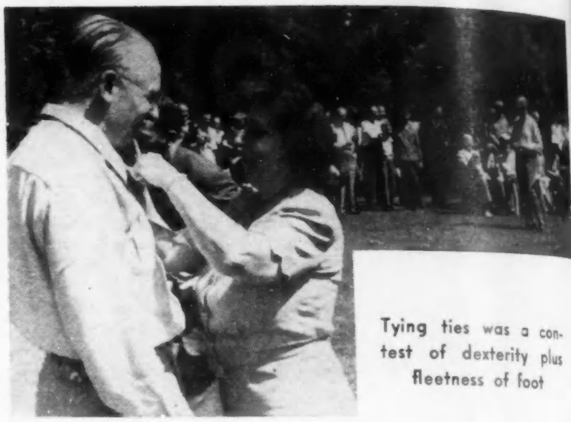
Automotive Power Trains, Clutches, Transmissions, and Steering Mechanisms – E. F. NORELIUS, Allis-Chalmers Mfg. Co.

EXHIBITED in German design of clutches, transmissions, and steering mechanisms were a lack of simplicity in thinking and the inadaptability to production methods as we know them.

A great deal of effort was made in cutting out clutch plates to avoid warpage. A method utilized to give positive plate separation on multiple disc clutches consisted of a bent tang on the outer circumference of the plate to press against the adjacent plate. Plate separation in one type of friction clutch was obtained using a spring lever.

An interesting development in transmission design was a combination hydro-kinetic and mechanical unit, known as the "Mekydro." The principal feature of this torque converter, Mr. Norelius stated, was the axial shifting of the turbine wheel by a hydraulic cylinder. The fluid friction of the pump is overcome by a second set of blades with reverse curvature. This arrangement makes possible a neutral sufficient to shift gears at idle engine speeds.

Used in lieu of the conventional American steering methods were various types of epicycle devices. The epicycle train used on the Panther tank permitted a radius turn or could be operated as a clutch and brake type for making pivot turns. The Tiger tank epicycle steering configuration provided two different radii of turn by means of a separate power input. Two types of hydrostatic means for steering, in combination with the epicycle train, were under development but never reached the production stage.



Tying ties was a contest of dexterity plus fleetness of foot

Chassis Developments in the German Automotive Industry – A. M. WOLF, Consulting Engineer

THAT there were no really new developments in chassis of nonmilitary passenger cars and commercial vehicles not known prior to the war is understandable, Mr. Wolf explained, since few new cars were built during the war. Relatively low German production – the largest truck manufacturer had a maximum output of 500 to 600 vehicles per month – permitted features that would not be tolerated in mass production.

For example, the central chassis lubricating system formerly used by Packard and Nash was found on every German car and truck. Although there are certain undeniable advantages to this system, our production lines would be slowed up by stringing "spaghetti" throughout the chassis. Another design found to predominate in vehicle construction was the unit frame and body.

No rigid front axles were used other than those used on the German Ford. BMW utilized a torsion bar suspension for the rear comprising a longitudinal bar at each side, inside the frame rail, running toward the rear from a cross member under the front seat. It terminates in a shock absorber unit ahead of the rigid rear axle and an outwardly extending lever transfers the weight to the axle housing through a spherical jointed shackle link.

Since the suspension system, in many cases, takes the place of the rigid axle, the word "axle" in German terminology has been broadened to incorporate the entire suspension and axle members where a rigid axle bed or housing has been discontinued.

Swinging axles are quite popular and caused considerable anxiety among American personnel when the wheels showed a "bow legged" condition, Mr. Wolf related, especially when jacking up the car. Still used in the smaller passenger cars and trucks are mechanical brakes. Air brakes predominate the commercial field due to the popularity of 4-wheel trailers.

BUSINESS SESSION

Outstanding feature of the SAE Business Session was a message of appreciation from President George W. Mason of the Automobile Manufacturers Association delivered by H. W. Alden, Timken-Detroit Axle Co., in commemoration of the automotive industry's Golden Jubilee.

In conveying the message, Col. Alden, oldest living SAE Past-President and only one to hold the office twice, stressed its importance and significance. The AMA credited the success of the industry today to technical skill in automotive engineering contributed by SAE members.

Only through the unstinting and untiring efforts of the SAE, the message continued, was it possible for the indus-

try to achieve the high degree of development exhibited in the present-day car. Safety, comfort, and economy features now available to the public are the direct result of the Society's vast technical contributions to the art since the dawn of the horseless carriage era.

Not only this country, but the entire world has shared the benefits of the practical and sound engineering thinking and enlightenment and owes the SAE and its members a debt of gratitude. It is hoped, Mr. Mason concluded, that the close SAE-industry cooperation experienced these many years will continue in the future toward the realization of still greater heights of endeavor in the ever challenging realm of automobile improvement.

The other item of business concluded at the meeting was a report by A. T. Colwell, Thompson Products, Inc., chairman of the Advisory Committee to the Council, regarding a proposal to change the name of the SAE. Mr. Colwell reported that an extensive survey and careful analysis had not revealed a sufficient reason to warrant a change of name for the Society. In consequence, the Advisory Committee to the Council unanimously recommended that the Society's name should remain unchanged. President Buckendale reported to the Business Session that the Council agreed with this recommendation. Proposed as a formal motion at this Business Session, it was voted that the Society's name should remain unchanged.

SAE Engineering Displays Highlight Progress Of Product Design at Golden Jubilee

MAY 29 to June 9. Those were Detroit's Automotive Golden Jubilee days.

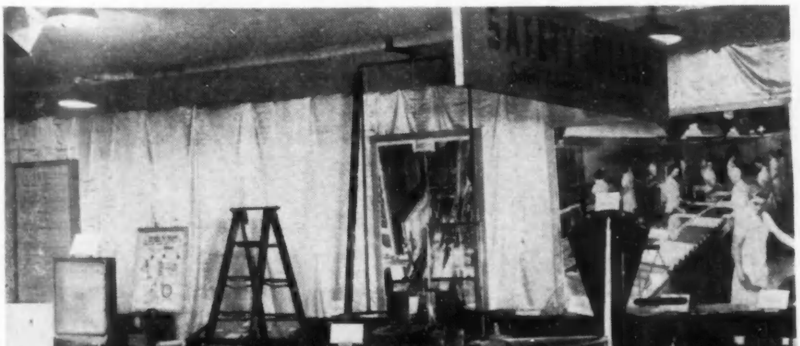
And the Motor City really put aside its reconversion headaches long enough to defend successfully its claims to the title of "Dynamic Detroit."

Its two million breathless inhabitants are still rubbing their incredulous eyes after a dizzy 10-day whirl that took them in review from 1896 and the get-out-and-get-under days of the rear-entrance tonneau, tallyho basket, surrey top with fringe, horizontal engine and tiller steering through 50 years of spiralling progress to today's threshold of rear-mounted engines, plastic bodies, and radar controls.

High up on the list of Golden Jubilee attractions was the Safety Exhibit sponsored by the Detroit Section of the SAE and occupying 10,000 square feet of floor space in the Antique Automotive Exposition at Convention Hall. There in one month's time 97 engineers working on SAE committees brought together from 64 individual and car down Woodward in 1896, came back company contributors the material to tell graphically and in animated fashion the story of 50 years of progress in the design of the engineering features that have contributed most to the safety of the motor car.

The SAE Safety Exhibit quickly became the center of attraction for the throngs which milled through Convention Hall from June 3-9 inclusive. Public and experts alike, who characterized it as the most instructive and complete historical exhibit of safety features ever assembled, realized how inseparable have been the success of the automobile industry and automotive engineering.

SAE was given an honored place in the Golden Jubilee Automotive Hall of Fame along with Edgar L. Apperson, William Crapo Durant, J. Frank Duryea, Henry Ford, George Holley, Charles B. King, Frank Kwilinski, Charles W. Nash, Barney Oldfield, Ransom E. Olds, Alfred P. Sloan, Jr., Charles S. Snyder, John Van Benschoten and John Zaugg, pioneer manufacturers, auto dealers, factory workers and race drivers who received special tribute throughout the Golden Jubilee celebration.



Properly to stage the Jubilee the City spent $200,000 in street decorations. Famous Woodward Avenue was turned into a fairyland, even its pavement being given a coat of gold paint from Grand Circus Park to Jefferson Avenue. It was over this route that the two and one half hour historical parade passed on Saturday, June 1. In the parade were 72 floats, 25 bands and 225 antique cars built prior to 1915, depicting primitive transportation and the various stages of progress up to the automobile, and the 50 year progress in the automobile itself. The Queen of the Jubilee rode in the Royal Float, while racial groups, industrial and labor organization floats and the military completed the parade.

Throughout the Jubilee period there were numerous special events while many of radio's outstanding chain broadcasts emanated from Detroit, and a host of Detroit's famous oldtimers from Ty Cobb and Barney Oldfield to Charles B. King, who drove the first to lend a hand.

Safety Exhibit

For the Convention Hall Safety Exhibit the SAE Detroit Section Steering Committee consisting of A. W. Frehse, general chairman, Chevrolet Motor Division; J. E. Hale, Firestone Tire and Rubber Co.; W. S. James, Ford Motor Co.; George L. McCain, Chrysler Corp.; V. J. Roper, General Electric Co., with R. C. Sackett, SAE-Detroit, as secretary, set up 10 main engineering and constructional features, each with a subcommittee, as the principal contributors to automotive safety. Each of the 10 features

had its own space or booth in the Safety Exhibit, and each member of the Steering Committee sponsored two or more of the features.

The 10 exhibit features and their subcommittee chairmen were:

Brakes – B. E. House, Bendix Products Division, South Bend.

Safety Glass – J. L. McCloud, Ford Motor Co., Dearborn.

Bodies, Vision – E. J. Deisley, Edward W. Budd Mfg. Co., Philadelphia.

Lights – J. H. Hunt, General Motors Corporation, Detroit, Mich.

Tires, Rims, Wheels – J. E. Hale, Firestone Tire & Rubber Co., Akron.

Noise and Vibration – Paul Huber, General Motors Proving Ground, Milford.

Chassis, Steering, Handling, Controls, Clutches, Transmissions – E. H. Smith, Packard Motor Car Co., Detroit.

Car Inspection and Maintenance – T. F. Walker, Hinckley-Myers Division, Kent-Moore Organization, Jackson.

Materials – E. W. Upham, Chrysler Corporation, Detroit.

Accessories – E. F. Webb, Chrysler Corporation, Detroit.

Approximately $100,000 went into the Safety Exhibit in materials, construction, murals, electrical work, attendants, et cetera. Ninety thousand dollars of this came out of contributors' pockets while $10,000 was appropriated by the AMA from the Golden Jubilee budget.

The committees used as their starting point the report of the Engineering Subcommittee of the President's Safety Conference around which to build the exhibit.

One major point was kept in mind and that is that during the 50 years of automotive progress automotive engineers have kept continuously far ahead of all other groups in their realization of the importance of safety in automotive design.

To impress that idea on the visitor to the exhibit the signs over all Safety Exhibit spaces carried this slogan—

"Safety
Advances thru
Engineering."

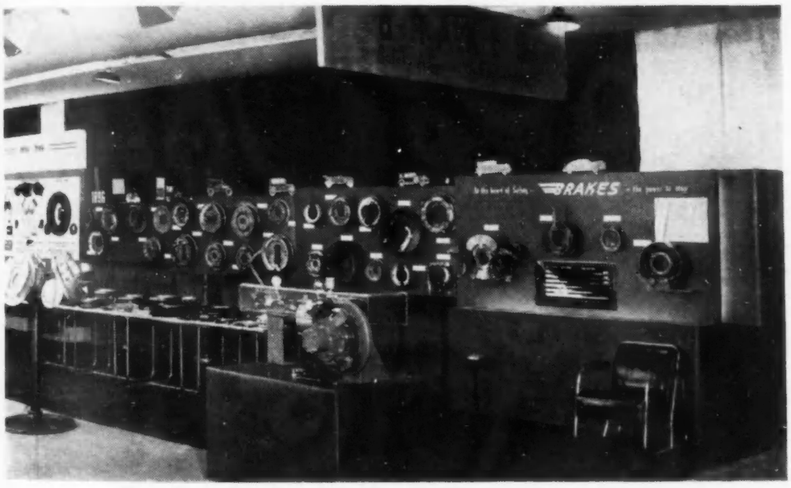
In the three exhibits on brakes, chassis and bodies, silent, continuous motion pictures were shown in shadow boxes. To select and prepare these films the Steering Committee spent hours reviewing some thirty films collected all through the industry. They had to be cut and captioned to eliminate all commercialism, for it was one of the self-imposed rules of the Safety Exhibit committees that the only advertising permitted was the names of contributors on attractive credit cards in each of the ten spaces.

Highlights of the 10 features of the Safety Exhibit included:

Brakes. In this exhibit were some 30 examples of brakes of all periods from the small, narrow, leather lined contracting brakes of the nineties to the most modern four-wheel braking systems. Working models of modern vacuum brake and air brake systems were in operation. This exhibit was built and assembled at Bendix Products Division and trucked to Detroit ready for installation. A movie showed brake testing and stopping distances.

Safety Glass. Center of attraction here was an actual pendulum impact test which broke thousands of panes of glass and showed the public the relative impact strength

f plate glass, heat treated glass and laminated safety glass. A torsion test also showed the relative strength of laminated safety glass and heat treated glass. A punch test permitted the public to test its fists on the plastic properties of vinyl material used in the laminated sandwich. Two large photographic murals showed important operations in the manufacture of laminated and heat treated safety glass. Glass manufacturers provided the technical attendants.



Bodies and Vision. Five actual bodies showed the principal steps in the progress of body construction. They were an open touring car body, wood closed body, composite closed body, steel open car body and the all-steel top closed body. Cut-out sections of the various types showed the progress in the details of safety construction. Large photographic murals filled in more details of design. A movie showed many thrilling body tests and the body manufacturers provided the technical attendants.

Lights. Central theme was a 40 ft long darkened tunnel in which the spectator could actually see the advances made in road illumination. Also, the necessity of dimming or depressing the light beam was stressed. On the side of the tunnel were ten framed transparencies in which were displayed a complete historical exhibit of lights from the old carriage type oil lamp and the gas light to the modern sealed-beam headlight.

Tires, Rims, Wheels. Animation marked this exhibit which was assembled and built by the rubber companies in Akron and trucked to the Exhibit. Focal point of the exhibit dramatized the parallel growth in speed and safety by the use of moving miniature car models depicting three different eras – that of the old high pressure tire, the high pressure cord tire and the modern balloon tire. Five built-on panels showed the progress in tire, rim and wheel design during a ten-year period as to (1) internal construction, cord materials and compounding; (2) external construction, sizes, treads, types of beads, et cetera, and (3) inner tubes.

Progress in durability with increased uniformity and lower costs were also shown.

Noise and Vibration. A tunnel lined with the most modern insulating materials depended upon audience participation to show how noise is diminished as the spectators passed through the tunnel. A complete set of modern mechanical rubber insulating and deadening parts was mounted on a plastic chassis to show the important safety effect the elimination of noise and vibration has on the motorist.

Chassis. Progress in chassis construction was shown with three chassis, an early 1903 wood frame, then a 1906 cutaway chassis and a 1946 chassis. Development of frame construction up to the modern box-type was shown in cross-section. There was an exhibit of the several stages of steering gears from tiller through split nut, rack and pinion and modern worm type. An exhibit of transmissions included the oldest planetary vintage, the in-between progressive sliding gear, the first selective type, the synchromesh and finally a modern automatic transmission. There was an animated knee-action exhibit, an historical display of shock absorbers, both rigid and flexible rubber motor mountings, and an engine starter exhibit. Also, a truck axle display. Movies and a number of large photo murals played an important part in this exhibit.

Car Inspection and Maintenance. An eighty foot safety inspection lane showed the importance to safety of brake, headlight and steering inspections. Wheel aligning, wheel balancing and frame straightening and their importance to safety were also depicted.

Photo murals and safety inspection charts completed this part of the exhibit.

Materials. Exhibits of actual life tests, fatigue tests and stress analysis of parts and materials featured this part of the exhibit, including a brake hose whip test, oil line fatigue test, tie rod boot test, steering gear assembly fatigue test and crankshaft fatigue test. The use of X-Ray in testing was shown, also a display of Magnaflux and Magnaglo testing of vital safety parts. Photo murals showed X-Ray panels, various test samples and a number of large cross sections of steel structures.

Accessories. Actual first models of such important accessories as horns, magnetic speedometers, fuel systems, et cetera, were displayed. Many of these items are the priceless possessions of their inventors and owners. The story of the windshield wiper was told with a working display of the modern wiper using water and dirt to make it more realistic. Heater displays extended back to the days of soap stones, charcoal heaters and exhaust heaters. The progress of directional signals was shown. What the cigarette lighter means to safety was shown in model, mural and poster. Posters and murals formed a vital part of this exhibit.

The following is a list of the contributors to the Safety Exhibit and a list of the 97 engineers who gave weeks of their time and effort to this most successful Safety Exhibit:

Contributors to Golden Jubilee Safety Exhibit

Sponsored by the Society of Automotive Engineers, Inc.

Brakes: Bendix Products Division, Bendix-Westinghouse Auto. Air Brake Co., Budd Wheel Co., Chrysler Corp., Kelsey-Hayes Wheel Co., Motor Wheel Corp., Raybestos-Manhattan, Inc., Timken-Detroit Axle Co., and Wagner Electric Corp.

Safety Glass: American Window Glass Co., Ford Motor Co., Libbey-Owens-Ford Glass Co., and Pittsburgh Plate Glass Co.

Bodies – Vision: Briggs Mfg. Co., Edison Institute, Edward G. Budd Mfg. Co., Chrysler Corp., Fisher Body Division, General Motors Corp., Hudson Motor Car Co., Packard Motor Car Co., and Studebaker Corp.

Lighting: Chrysler Corp., Electric Auto-Lite Co., Ford Motor Co., General Electric Co., Guide Lamp Division, General Motors Corp., K-D Lamp Co., and Hall Lamp Co.

Tires, Rims, Wheels: Budd Wheel Co., Firestone Tire & Rubber Co., B. F. Goodrich Co., Goodyear Tire & Rubber Co., Kelsey-Hayes Wheel Co., Motor Wheel Corp., and U. S. Rubber Co.

Noise and Vibration: AC Spark Plug Division, General Motors Corp., Baldwin Rubber Co., Buick Motor Division, General Motors Corp., Cadillac Motor Division, General Motors Corp., Chevrolet Motor Division, General Motors Corp., Chrysler Corp., E. duPont de Nemours & Company, Inc., Firestone Steel Products Co., Ford Motor Co., General Motors Proving Grounds, Hayes Industries, Inc., J. W. Mortell Co., Nash-Kelvinator Corp., Plymouth Motor Co., and Studebaker Corp.

Chassis: Borg-Warner Corp., Chrysler Corp., Diamond T Motor Car Co., Edison Institute, Electric Auto-Lite Co., Federal Motor Truck Co., Firestone Tire & Rubber Co., Gabriel Co., Gemmer Mfg. Co., General Motors Corp., Houdaille-Hershey Corp., John Warren Watson Co., Midland Steel Products Co., Monroe Equipment Co., Nash-Kelvinator Corp., Packard Motor Car Co., B. J. Pollard, Ross Gear & Tool Co., Sheller Mfg. Corp., Spicer Mfg. Corp., Studebaker Corp., Timken-Detroit Axle Co., and Willys-Overland Motors, Inc.

Inspection and Maintenance: American Brakeblok Division, American Brake Shoe Co., Bear Mfg. Co., Chrysler Corp., General Motors Proving Ground, Kent-Moore Organization, Pontiac Motor Division, General Motors Corp., State of Illinois, Stewart-Warner-Alemite Co., and Weaver Mfg. Co.

Materials: Chrysler Corp., Eastman Kodak Co., Ford Motor Co., Research Laboratories Division, General Motors Corp., and Magnaflux Corp.

Accessories: AC Spark Plug Division, General Motors Corp., Bishop and Babcock Mfg. Co., Buick Motor Division, General Motors Corp., Casco Products Co., Chrysler Corp., Delco Remy Division, General Motors Corp., Eaton Mfg. Co., Electric Auto-Lite Co., Ford Motor Co., Hudson Motor Car Co., Nash-Kelvinator Corp., Packard Motor Car Co., B. J. Pollard, Trico Products Corp., Stewart-Warner Corp., United Specialties Co., and A. P. Warner.

SAE SUMMER MEETINGS were held in 1906, 07, 08 and 09 in New York, Buffalo, Detroit, and Chicago, respectively. Records of subsequent meetings are:

YEAR	PLACE	ATTENDANCE	SESSIONS
1910	Detroit	167	?
1911	Dayton	288	4
1912	S. S. City of Detroit	400	4
1913	S. S. City of Detroit	435	4
1914	Cape May, N. J.	370	5
1915	S. S. Noronic	452	?
1916	S. S. Noronic	554	5
1917	Washington, D. C.	704	2
1918	Dayton	900	4
1919	Ottawa Beach, Mich.	834	9
1920	Ottawa Beach	815	9
1921	West Baden, Ind.	698	8
1922	White Sulphur	561	6
1923	Spring Lake	804	4
1924	Sprink Lake	732	6
1925	White Sulphur	714	7
1926	French Lick	787	8
1927	French Lick	745	9
1928	Quebec, Canada	851	10
1929	Saranac	731	9
1930	French Lick	690	12
1931	White Sulphur	526	13
1932	White Sulphur	262	11
1933	none		
1934	Saranac Inn	549	18
1935	White Sulphur	610	14
1936	White Sulphur	624	17
1937	White Sulphur	514	14
1938	White Sulphur	550	15
1939	SAE World Automotive Engineering Congress, Coast to Coast		
1940	White Sulphur	635	15
1941	White Sulphur	731	15
1942	none		
1943	none		
1944	none		
1945	none		
1946	French Lick	950	21

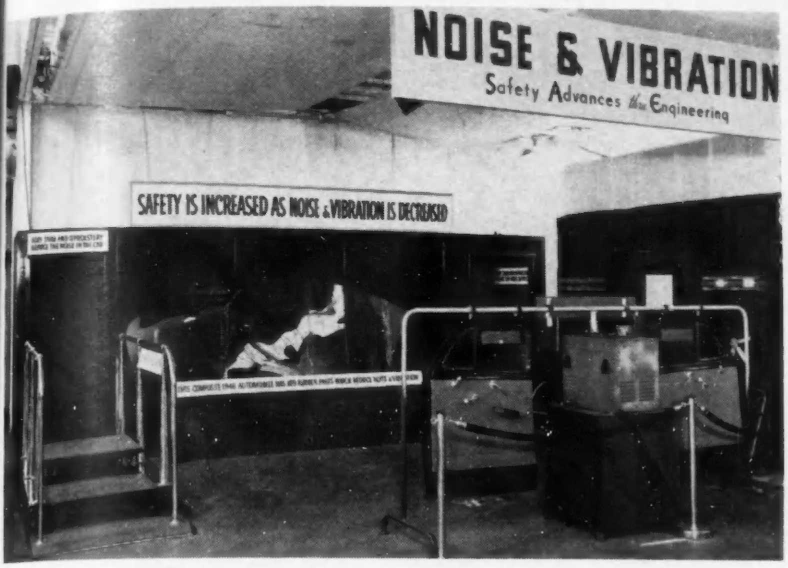
Members of SAE Golden Jubilee Safety Committee

J. O. Almen, Research Laboratories Division, General Motors Corp.; C. W. Auklam, Hall Lamp Co.; J. J. Barrett, Bishop and Babcock Mfg. Co.; L. L. Beltz, Ford Motor Co.; J. W. Benson, American Window Glass Co.; G. Benya, Briggs Mfg. Co.; W. Berry and F. Black, Nash-Kelvinator Corp.; W. S. Brink, Firestone Steel Products Co.; and W. F. R. Briscol, U. S. Rubber Co.

B. B. Cary, Hayes Industries, Inc.; Tracy Carrigan, John Bean Mfg. Co.; Gardner M. Cobb, General Motors Corp.; E. J. Deisley, Edw. W. Budd Mfg. Co.; H. W. Delzell, B. F. Goodrich Co.; Harry Denyes, Gemmer Mfg. Co.; Harry Doane, Buick Motor Division, General Motors Corp.; J. A. Dykstra, General Motors Corp.; M. H. Elkin, Hudson Motor Car Co.; and J. Engstrom, Chrysler Corp.

M. F. Erickson, J. W. Mortell Co.; R. D. Evans, Goodyear Tire & Rubber Co.; M. G. Forester, Packard Motor Car Co.; A. W. Frehse, Chevrolet Motor Division, General Motors Corp.; H. Habitz, Ford Motor Co.; J. E. Hale, Firestone Tire & Rubber Co.; E. P. Hawthorne, Budd Wheel Co.; C. E. Heussner, R. B. Hooper, and P. B. Hopkins, Chrysler Corp.

B. E. House, Bendix Products Division; H. J. Howerth, Stewart-Warner-Alemite Co.; W. H. Hulswit, Jr., U. S. Rubber Co.; J. Harold Hunt, Motor Wheel Corp.; J. H. Hunt, General Motors Corp.; Paul Huber, General Motors Proving Ground; A. B. Jackson, Chevrolet Motor Div., General Motors

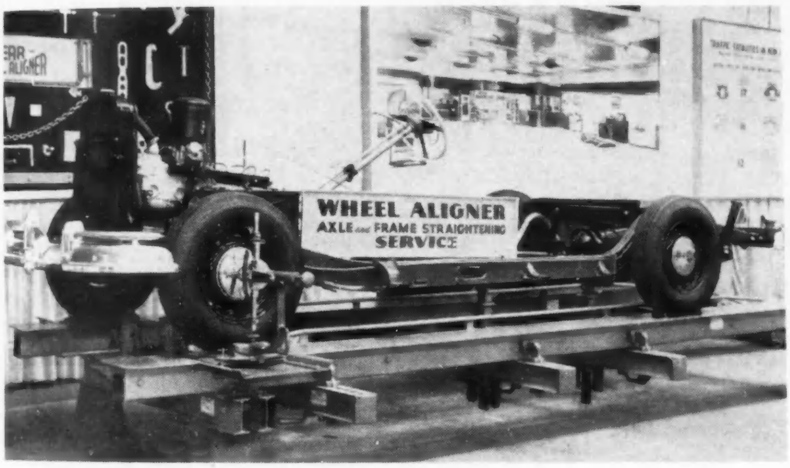


Corp.; W. S. James, and J. E. Jamison, Ford Motor Co.; and E. W. Jones, Chrysler Corp.

P. J. Kent, Chrysler Corp.; R. F. Kohr, Ford Motor Co.; A. G. Laas, Studebaker Corp.; R. H. Lanpher, Ford Motor Co.; C. E. Larson, Trico Products Corp.; John H. Little, Chevrolet Motor Division, General Motors Corp.; R. F. Littley and Donald G. Long, Edw. G. Budd Mfg. Co.; and K. S. Loring, Chrysler Corp.

William M. Mappes, K-D Lamp Co.; V. E. Matulaitis, Eaton Mfg. Co.; George L. McCain, Chrysler Corp.; J. L. McCloud, Ford Motor Co.; J. A. McLaine, American Brakeblok Division; C. W. McKinley, AC Spark Plug Division, General Motors Corp.; H. C. Mead, Guide Lamp Division, General Motors Corp.; G. E. Meese, General Electric Co.; R. A. Miller, Pittsburgh Plate Glass Co.; and R. L. Mitten, Firestone Tire & Rubber Co.

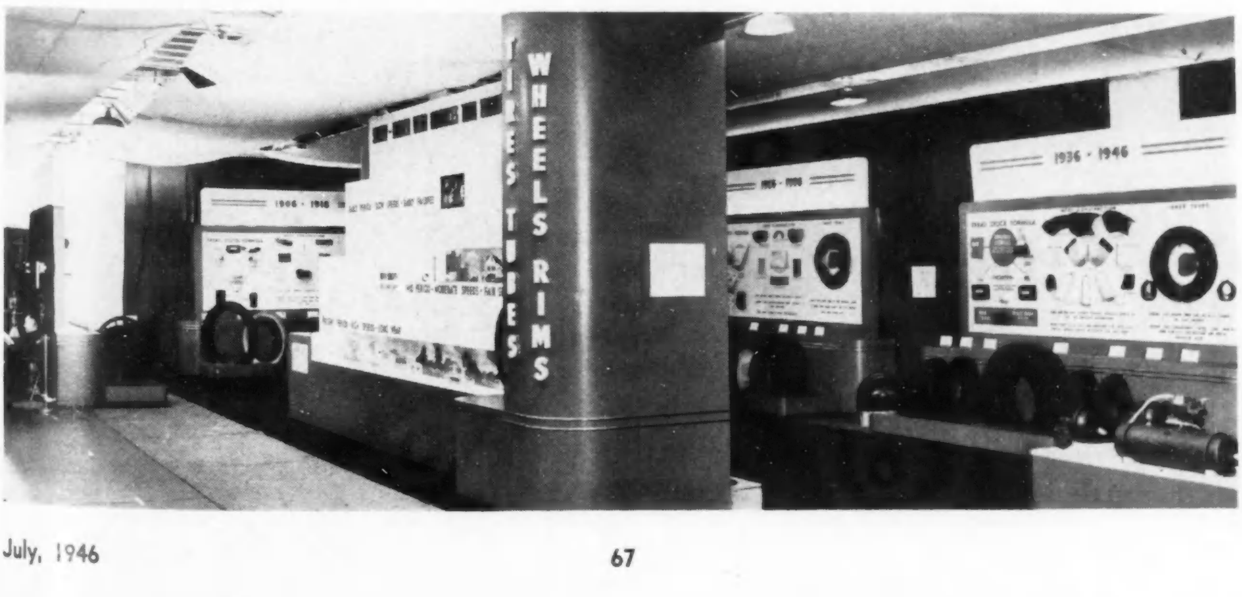
W. C. Mitts, Fisher Body Division, General Motors Corp.; C. W. Moore, Mitchell Specialties Co.; T. G. Moulding, Electric Auto-Lite Co.; W. I. Nyquist, Hudson Motor Car Co.; C. M. Olmstead, Ford Motor Co.; F. W. Parker, Jr., Timken-Detroit Axle Co.; H. B. Peck, Eaton Manufacturing Co.; A. W. Ray, Weaver Mfg. Co.; E. F. Reising, Firestone Steel Products Co.; F. V. Rhodes, Michigan Bell Telephone Co.; and V. J. Roper, General Electric Co.



R. J. Schaffer, United Specialties Co.; W. A. Shaver, Stewart-Warner Corp.; Charles Sinclair, Kelsey-Hayes Wheel Co.; R. W. Sinclair, Casco Products Co.; E. H. Smith, Packard Motor Car Co.; Joseph Smith, Monroe Auto Equipment Co.; W. W. Smith, Studebaker Corp.; R. Speerschneider, Ford Motor Co.; F. A. Stinson, Delco-Remy Division, General Motors Corp.; P. W. Sullivan, Studebaker Corp.; and L. L. Swartz, Bendix Products Division.

C. V. Tatham, Bear Mfg. Co.; M. B. Terry, American Brakeblok Division; Louis Thoms, General Motors Corp.; E. M. Tulus, Nash-Kelvinator Corp.; T. Tyken and E. W. Upham, Chrysler Corp.; Earl Wagar, Studebaker Corp.; T. F. Walker, Kent-Moore Organization; Dean Walters, Willys-Overland Motors, Inc.; and R. J. Waterbury, Chevrolet Motor Division, General Motors Corp.

George B. Watkins, Libbey-Owens-Ford Glass Co.; E. F. Webb, Chrysler Corp.; G. Wetherill, Stewart-Warner Corp.; L. A. Wine, Electric Auto-Lite Co.; P. O. Wright, Packard Motor Car Co.; and F. C. Young, Ford Motor Co.



APPLICATIONS Received

The applications for membership received between May 10, 1946, and June 10, 1946, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section: M. Gore Kemp, Charles L. Wight, Jr.

Buffalo Section: Clifford J. Lane.

Canadian Section: Stewart Bowman, John T. Easton, Alex L. Gray, Henry Lee, Basil Rabnett.

Chicago Section: Robert Anderson, Garold D. Anstine, Austin E. Carlin, James L. Dawson, George J. Derrig, Lt.-Col. William S. Lawrence, John F. Novacek, Jules A. Taylor.

Cleveland Section: Luis Arturo Buxton, Arthur E. Dekome, F. M. Falge, Delavan S. Mussey, Edward R. Sharp, Richard A. Sweet.

Detroit Section: Thaddeus M. Alexander, James G. Berry, Lt.-Col. Charles M. Buhl, John W. Fleischer, Robert P. Humphrey, Mahmut Velit Isfendiyar, Roderick Duncan MacRae, John James O'Malley, Walter G. Patton, J. McGill Reynar, Frank O. Riley, Charles H. Rose, Victor Samson, Joseph R. Seguin, Francis E. Smith, Richard C. Spooner, James E. Wilson.

Hawaii Section: Arthur Joseph Chang, Alvin T. Hanson, Cornelius J. Rose, James A. Hay Wodehouse.

Kansas City Section: John Edward Ferguson.

Metropolitan Section: Harry L. Baker, Otto Bernhard, Anthony Owen Bird, Kurt Erdmann, Harry J. Graham, Walter R. F. Guyer, Paul A. Harter, Philetus H. Holt, 2nd, Eugene J. Keenoy, Jr., J. Austin King, Antonio Idones, Hugo O. Laine, Earl A. Leonard, Edward Harold LeTourneau, Andrew Donald Lewis, R. Philip Luce, Jr., Bernard L. Moss, David B. Nichison, Daniel S. Orcutt, Theodore William Osbahr, Jr., Raymond A. Quance, Philippe L. Schereschewsky, Gerald W. Shuck, James Stockman, Dunlop Taylor, John Marshall Teague, William Bernhard Thelander, Jesse E. White, Jr.

Milwaukee Section: Carl J. Barbee.

Mohawk-Hudson Group: Mrs. Dorothy M. Shackelford.

New England Section: Jacques Cornillon, Walter W. Gleason.

Northern California Section: Carl A. Beck, Melvin O. Brogan, Frederick A. Christiansen, William Rowe Forsythe, H. F. Galindo, John A. Miller, Jr., Jack Neale Simonson, Carl E. Watson.

Northwest Section: Ed F. Oman, Jack B. Shayler.

Oregon Section: Jack H. Burns, Joseph L. Guthrie.

Peoria Section: James C. Porter.

Philadelphia Section: Robert T. Elliott, Ensign Daniel Howland, Lewis P. Litzinger, Jr., Robert M. Porro, Thomas M. Zimmerman.

Salt Lake City Group: H. K. Pringle.

Southern New England Section: Theodore Gurney, John J. Hospers, Marvin Lee Kline.

Southern California Section: Martin R. Bertolette, Reed M. Black, Edward M. Bonette, Robert O. Borst, John Robert Boyd, Gordon Niederer Brittle, Kenneth S. Carter, Lyell S. Collins, J. G. Derwingson, James L. Dooley, Peter Gilbert Gattie, Bruce Fulton Grimm, S. Kenneth Harman, Clark Hickerson, Philip M. Klauber, Arthur Dela-

turn to p. 70

NEW MEMBERS Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between May 10, 1946, and June 10, 1946.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Baltimore Section: T. Gardner Hill (M).

Buffalo Section: Rolly W. Fitch (M), Claude P. Hart (A), Cleveland L. Hildebrand (J), Howard C. Jones (M), Philip C. Rapp (J).

Canadian Section: William A. Connor (M), John Robert Fawcett (J), George Edward Otter (M), Stephen B. Plummer (M), David Richard Thom (A), Thomas Donald Wallace (A).

Chicago Section: Robert A. Ackerman, II (J), Chester M. Metra (SM), Frederick Stanley Nowlan (M), Hans S. Smyth (M), Charles E. Thrailkill (J), Henry A. Wachter (A), Richard Wysock (J).

Cincinnati Section: George Black (M), William R. Hummel (M), Paul J. Jung (M).

Cleveland Section: Carl E. Bricker (M), Harold B. Finger (J), Walter A. Franck (M), Ambrose Ginsburg (J), Harry S. Imming (J), Harry Kreizwald (J), Charles Allen Melton (J), Eugene R. Moyes (J), Joseph A. Rizzo (A).

Dayton Section: Frank A. Bailey (A), Robert S. Goebel (A), Chas. H. Marshall (M), Emil R. Marten (M).

Detroit Section: Herbert J. Arnold (M), Raymond A. Boyle (M), B. Gratz Brown (M), C. E. Greene (A), Ludwig A. Gribler (J), John R. Harder (M), Lawrence F. Hope (M), Toivo W. Huurto (J), Lee C. Jenne (J), Edward Zenas Jessop (M), John A. Matousek (A), Edward F. Mayne, Jr. (J), Lt. (jg) Max Myron McCray (J), Walter H. F. A. Noffke (A), John T. Rausch (M), Robert W. Ragen (A), Erland Reuter (A), James L. Roach (M), Michael C. Rogowski (J), Thomas Stock, Jr. (M), Glenn D. Tooker (M), Ray C. Ulrey (M), William W. Vesy, Jr. (A), Earl E. Wagner (M), James Edward Warrick (J), F. A. Wunderlich (M).

Hawaii Section: William A. Baddaky (A), William O. Harper (A), James Lodl, Jr. (A), Yale E. Smith (A), Joseph B. Stickney (A).

Indiana Section: Roy E. Adams (M), John R. Bennett (A), Gene A. Cormany (J), Melvin E. Estey (J), Wayne H. McGlade (M), Charles W. Ostertag (A), Paul Hubert Rogers (J).

Metropolitan Section: William Richard Barry (J), John M. Barstow (J), William Jay de Boer (A), Wilmer R. Decker, Jr. (J), Fernand L. Gerin (M), J. Van R. Kelly (A), Kenneth W. Lussen (A), Joseph V. Montuori (A), David E. Parker (SM), Elliot Schiller (J), Roland W. Sellis (J), I. P. Stafford (A), Donald James Stroop (A), Neilson F. C. Tomlinson (A), Henry W. Ungurath (A), Martin J. Vaccaro (SM).

Milwaukee Section: Lawrence J. Bernauer (J).

Mohawk-Hudson Group: John F. FitzGerald (M), Osmon A. Tilton (M).

New England Section: Thomas L. Callahan (A), Vincent J. Marino (J), John Cephas Martin (J), Comdr. O. C. Roehl (A).

Northern California Section: Albert O'Brien Bemiss (J), Herman J. Bihler (A), John P. Mathias (A), Walter W. Parkhill (A).

Northwest Section: John E. Hanson,

Jr. (M), Robert R. Mead (M), Walter Le Roy Perry (A).

Oregon Section: Clarence Bear (A).

Peoria Section: Ivan R. Lamport (J), Donald K. Strohschein (J).

Philadelphia Section: William Clinton Hale, Jr. (M), Avrel Mason (J), Wilbur B. Reed (J).

Pittsburgh Section: John Garrett Burke (J).

St. Louis Section: Wesley A. Harper (A), Samuel Bosley Parsons (A).

Salt Lake Group: Gregory V. Aberer (A), Raymond C. Brown (A).

Southern California Section: Capt. Seward H. Allen (J), Carl A. Anderson, Jr. (A), Lee E. Baldwin (M), Warren A. Bratfisch (J), Paul M. Browne, Jr. (J), Burton A. Chalmers (A), John E. Ekstromer, Jr. (A), Warren Ernest Fennell (A), Eugene F. May (A), E. G. McMannamy (A), Christian Nielsen (A), Herbert C. Noll (A), Arnold V. Pilling (J), Homer H. Rhoads (A), Ensign William A. Rubly (J), J. H. Severson (A), Foster S. Wood (J).

Syracuse Section: Cyrl Waldie Terry (M).

Twin City Section: Albert H. Eggert (J).

Washington Section: Chester Lawrence Belding (A), Frederic A. Middleton (M), Joseph E. Pauze (A), Gustave B. Sandin (A).

Western Michigan Section: John T. Derrickson (A), Edward J. Picard (A).

Wichita Section: Howard Agnew Smith (M).

Outside of Section Territory: Herbert M. Bevans (J), T. W. Culmer (M), Donald P. Gardner (M), Donald S. Kleckner (A), Lewis E. Rice (A), Clifton C. Stevens (A).

Foreign: Charles Edward Day (FM), England; Clarence Frank Nossiter (FM), England; Alexander Robert Ogston (FM), England; Lionel Stern (FM), Australia; Stephen Lloyd Tucker (M), India; J. J. C. Voerman (FM), Holland; John William Warrington (FM), England.

Applications Received

cont. from p. 68

field Johnson, Leon E. Rope, T. Claude Ryan, Werner Schwyzer, Hunley E. Seaton, Jr., Lt.-Com. John G. Sheridan, Joseph A. Sharp, Lloyd C. Starkweather, Myron Tribus, Elmer L. Wattenbarger, Jerome J. Wheeler, Jr., Castleman Wilson.

Syracuse Section: Alfred P. Gallaurei.

Texas Section: Melvin B. McCracken, John Frederick Steppe.

Virginia Group: Lucien W. Bingham, Jr., William H. Bingham, Harold Norweed Tyler, Jr.

Washington Section: Luther M. W. Bolton, Lt. Carroll K. Bransford, William Fowler Duncan, Samuel M. Lauderdale.

Western Michigan Section: George E. Dake, Jr.

Outside of Section Territory: Arthur Armstrong, James F. Bly, Pete Y. Burns, C. S. Carswell, Frank Leslie Hoover, Thomas George Hewitt, James Russell Kerr, Lyman Burns McPherson, Charles O'Brien, Frank Davison, Lloyd T. Graves, Percy W. Hawtin, Horace D'Orsay Macdonald, Thomas Eric Swann, Burdette Trout, Stanley J. Turnill, William Herbert Welsh, Clarence H. Willis, Thomas Hilmar Wingen.

Foreign: Roland Claude Cross, England; Jack Eliot Duckham, England; Brian Leslie Mason Eardley, South Africa; Kenneth William Lenton, England; Thomas Gordon Lloyd, England; "Maquitrans" Maquinaria y Elementos de Transporte, S.A., Spain; Umberto Remigio Mazzarol, Australia; Vasanji Mulchand Meswani, India; Theo Sherwen, England; Percy Southern, England.

FOUNDRIES

cont. from p. 38

from one to 10 or 12 grains per cu ft, and air temperature varies from below zero to over 90 F. In addition, a considerable quantity of the Btu content of the coke would be expended in vaporizing the water from uncontrolled air blast.

By-product coke is superior to bee-hive coke, according to Mr. Thomas. He stated further that analysis of good coke should show a fixed carbon content of 92%, ash 6%, volatile matter 1-1.5%, sulfur 0.5-1% and moisture 0.5%. In general, the size of coke depends on the size of the cupola.

Today's steel scrap is very poor in quality, he said, and modernization in this area calls for grading, binning and automatic weighing, with charging materials arranged in bins in horseshoe fashion. With this system, it is possible for one man and a relief man to charge 20-30 tons per hr. Thirty years ago, he said, cast iron had a tensile strength of 15,000-20,000 lb per sq in; today, under quality control and careful inspection, cast iron is made to have a tensile strength of 35,000 lb per sq in – 50,000 lb with inoculation.

Regarding the inoculation of base metal for small castings, he stated that this was not completely satisfactory because of the temperature drop induced by inoculation. Better way is to run a cupola on soft iron and another on hard iron. Higher percentage steel mixture produces more linear shrinkage, he said, but shrinkage may be held down by keeping phosphorous content low.

Cost, too, is an item of first degree importance.

Cost and proper moisture content are items of prime importance in sand molding. Synthetic sand is preferred for its low moisture content. In any case, he said, sand control is necessary for consistent castings because moisture content, permeability and grain size must be regulated.

Discussing the new development of molding sands which require no water, but use a polymerizing petroleum product, he reported that although initial cost is somewhat higher it is offset by lower cleaning room costs. Core drying time may be reduced considerably by the use of infra-red rays for baking and drying.

Flight Engineer Function Dictates Station Design

Digest of paper

by **M. F. VANIK**
Boeing Aircraft Co.

▪ Air Transport Meeting, Dec. 4

(*Paper entitled "Flight Engineer Station Design and Requirements"*)

DESIGN of the flight engineer's station should be determined by the type of airplane operation and the function the flight engineer is to serve as related to the basic factors of safety, efficiency of operation, and economy.

Safety considerations, as covered in CAA regulations for a flight engineer or flight mechanic, are very flexible and the requirements are based upon the airplane design or operation being conducted. Reasons for requiring a flight engineer, according to Mr. Vanik's interpretation of Par. 61.52 of Civil Air Regulation, are to prevent: too high a work load for safety, premature fatigue, interference with proper navigation, and interference with proper operation.

Creation of an arrangement providing for maximum efficiency by the manufacturer involves consideration of the many different types of operations which may be anticipated by all prospective customers. For this purpose it is necessary, based on recent concepts in determination of the anticipated overall pattern, to consider the flight engineer's basic functions and their correlation to the basic types of operation.

The simplest function the flight engineer may serve is that of a pilot aid. In this role he acts, not as a technician, but as added hands and eyes to supplement those of the pilot and co-pilot who are more involved in proper handling of the airplane to execute a difficult landing, an instrument approach, or to control an emergency flight condition. Use of a flight engineer for this purpose alone, especially for short domestic trips of 1 to 4-hr duration, is not necessary and no

special provision need be made for him.

On long range domestic operations of 6 to 8-hr, the use of a flight engineer will increase. He will also serve a second function on such flights, as a powerplant technician – to accomplish the necessary constant check on powerplant performance and maintain running records on engine performance, fuel, and oil consumption to achieve maximum efficiency. The need for a full-time powerplant technician is not critical, according to Mr. Vanik, on domestic long range operation where adequate landing fields are frequently available.

As a flight mechanic on long range intercontinental operation, where flights are of 8 to 10-hr minimum duration, the flight engineer becomes an important member of the crew. In addition to the two duties mentioned above, he is needed to make frequent adjustments and repairs of numerous equipment items such as multiple fuel selector systems, emergency electrical, hydraulic, and manual systems, and heating and ventilating equipment. For this type of operation, the total functions of the flight engineer are definitely needed and he should be a standard member of the crew.

In designing the flight engineer station for the engineer acting as pilot aid, maximum coordination of engineer and pilot should be allowed. The ideal arrangement is to give the flight engineer access to, and a view of, the same operating instruments directly from the pilot's primary panel. Equipment such as fuel and oil selector switches and generator voltage and current switches may be efficiently mounted on an overhead panel between the pilot and the co-pilot, accessible both to them and the flight engineer located immediately behind them.

Such an arrangement, Mr. Vanik noted, provides for maximum of coordination and efficiency of operation, eliminates unnecessary duplication of controls and instrumentation, and causes a minimum of confusion. A weight saving of 300 to 500 lb may be achieved by this plan as compared to a separate flight engineer's console.

For intercontinental routes where the flight engineer is considered a standard crew member, some operators prefer a separate compartment for the engineer due to his continuous and more extensive duties. In such cases, the engineer's panel should still be located as close as possible to the pilot and co-pilot; but will probably be so extensive as to require a location along the right side of the control cabin. The flight engineer should face forward, if possible, to be in the same relative position as the pilots with respect to engine locations. Next best choice is placing of the engineer's station and panel fore and aft for view of instruments and controls by the pilot with a minimum of effort.

Advent of six and eight-engine airplanes will so complicate cockpit operations as to constitute a serious hazard, Mr. Vanik predicted. Future development calls for greater simplicity of multi-engine cockpit operation than is now available in two-engine planes. Automatic cowl flap mechanism, fire extinguishing systems, and flight control are just a few simplifications for future consideration in making multi-engine cockpit operation less cumbersome.

Aircraft Control Decks Planned for Crew Comfort

Digest of paper

by H. J. CHASE

Pan American Airways, Inc.

■ Air Transport Meeting, Dec. 4

(*Paper entitled "Control Decks for Long Range Aircraft"*)

DESIGN of control decks for long range aircraft based primarily on functions and needs of the crew members must be realized if flight personnel is to operate efficiently, Mr. Chase urged, especially in view of a tendency toward four-men crews as the speed and frequency of schedules increase. Greater consideration should be given, he feels, to crew station location, vibration elimination, improved visibility, lighting, and instrumentation, and elimination of personnel hazards.

Requirements for location of crew stations are ever-changing and vary with individual airlines. Therefore, only basic principles are proposed for consideration, namely: relative distance between the pilot and co-pilot; relation of pilot and co-pilot to the instrument panel and controls; location of flight engineer's station behind the co-pilot, and

positioning of the radio operator's and navigator's stations.

The next problem, vibration, is extremely fatiguing and reduces the efficiency of flight personnel. Shock mounting of instruments, the instrument board, and radio gear is only the beginning of vibration elimination. The engineer's ultimate goal should be the design of a fuselage and all component parts as vibration-proof as possible from both mechanical and aerodynamic vibrations. Not impractical is the shock mounting of crew stations, chairs, and even the control deck.

Adding to eye strain, fatigue, limited visibility, and resultant lowered safety standards is the present construction of two small windows with their molding directly in line of vision of the pilots. Visibility should be provided in all directions with curtains available to blanket any glare. Poor lighting is another factor that contributes to eye strain and fatigue, as well as nervous irritation the pilot sometimes undergoes with the distracting variety of lights. To be satisfactory, lighting must eliminate glare, make all instruments readable, and provide variable intensity of illumination.

The only point agreed upon in the present chaotic status of cockpit instrument standardization is the location of flight instruments. Vertical type of indication, for example, would be desirable in certain instruments. Study should be devoted to dials and dial graduations, Mr. Chase observed, to facilitate their readability by the crew members.

The last phase of design open to improvement is the elimination of personnel hazards. Still to be found in present aircraft are protruding parts, sharp corners, insufficient padding, and limited freedom of movement and clearance.

Proper Ground Facilities Speed Up Airline Flights

Digest of paper

by H. S. PACK

P-V Engineering Forum, Inc.

■ Air Transport Meeting, Dec. 3

(Paper entitled "Latest Developments in Airline Ground Equipment")

MAXIMUM utilization of the airplane and full exploitation of its air speed is nullified if excessive time is lost in ground servicing operations. Emphasized by Mr. Pack was the need for management to recognize the importance of investing in ground equipment to save time and money in airline operation.

Scheduled speed of an airline – the item of greatest interest to passengers and shippers – is the elapsed time between two terminal points. But to appreciate the overall picture, Mr. Pack reported that speed in scheduled operation is not only dependent upon cruising speed, but also on actual ground time. Therefore, an airplane with a higher cruising speed has no advantage over one designed to permit shorter ground stops, and is able to maintain the same scheduled speed as the first aircraft between any two terminal points with a given number of intermediate stops.

From the above, it is obvious that a balanced relationship must be maintained between flying, ground, and maintenance time for most efficient operation. To improve one, all must be improved to attain the desired end result. Proportionate improvement of all, however, has not been achieved to date since only flying speeds have been bettered.

Economies Possible

Recent studies point to the possibility of marked improvements in time and efficiency through utilization of mechanical ground equipment in service. Vital to a program of this nature are procedures; and the two basic approaches are the simultaneous or staggered performance of ground servicing operations. Simultaneous operation would require an unduly large ground crew and labor costs would rise out of all proportions. Staggered operations, on the other hand, would require excessive ground time and increase direct flying costs. Obviously, the procedures and equipment should be thoroughly coordinated. Mechanizing to shorten one operation by itself will not shorten ground time – for example, reduction in re-

fueling or loading time will be of no benefit unless the whole program is speeded up.

Recognizing the importance to the industry of coordinating ground equipment with aircraft and airport design, the Air Transport Association undertook a comprehensive program of developing passenger handling, cargo and baggage handling, and service and maintenance equipment. The fruits of this effort emerged in the form of specifications covering requirements for 44 items of equipment under the three categories mentioned.

Typical of these specifications is one covering three types of portable stands – fixed height, hand-propelled, and adjustable – intended to allow passenger traffic to move between the ground and the plane when the loading door is some distance above ground. Features specified are: adequate base stability, adequate illumination, antiskid material for walking surfaces, and padded bumpers provided at all points where the unit contacts the airplane.

Specifications for cargo and baggage handling equipment include such items as cargo and baggage handling units, cargo trucks, equipment covers, fork lift trucks, and tractors. The scope for service and maintenance facilities is equally great, covering equipment from commissary units to control surface locks.

Ride Comfort, Safety, Suspension Requisites

Digest of paper

by H. E. CHURCHILL, P. G. HYKES, and M. Z. DELP

Studebaker Corp.

■ Annual Meeting, Jan. 9

(*Paper entitled "Fundamentals of Suspension"*)

PROVISION of mental and physical comfort as well as safety for occupants should be the fundamental requirements of a vehicle suspension. Equally as important as the motion characteristics usually associated with the suspension system are passenger space and location considerations.

The combination of spring rates and mass distribution, the major factors controlling the sprung mass of a car about its c.g., is referred to as the mass-elastic system. Even with an ideal mass-elastic relationship, variations in road surface and car speeds make it mandatory that suitable damping or restraint be included to control the motion. The oscillatory frequency should be kept within a range which causes the least disturbance to the human body.

Currently, this range varies from 70 to 100 oscillations per minute. However, recent developments in air transport have indicated that lower frequencies are not detrimental.

In one theory of motion, it is maintained that the best ride is obtained when the ratio of mass constant to elastic constant equals unity. Experimental data were obtained by the application of this theory in tests run on six different makes of cars with similar curb weights. Particularly noteworthy was the fact that the good riding cars had lower frequencies about the point around which rotation produces pitching in the rear seat. Another interesting observation in these tests was that the ride improves the nearer the ratio of mass constant to elastic constant approaches unity.

A factor affecting stability, front wheel rate, has dropped from about 300 lb per in., prevalent in 1933 models, to 75 to 90 lb per in. for 1942 models. Marked reduction in rates was achieved by the use of independent front suspension which brought an increased lateral roll due to the lower rates. This necessitated the use of antiroll devices in the design.

Passenger seating arrangement has gradually moved forward so that the passengers are disposed closer to the center of gravity of the vehicle. While the ride qualities are improved by placing the c.g. of the rear seat ahead of the rear axle and lower, this has made necessary a gradual forward movement of the engine with a tremendously increased weight on the front wheels. This trend will give rise to either a shorter and lighter powerplant or movement of the engine to the rear of the chassis.

Mass Distribution Affects Safety

Whereas the effects of the mass-elastic system on space and motion influence passenger comfort, as indicated above, mass distribution with reference to the front and

rear wheels also has an important bearing on the safety of the vehicle. The location of the c.g., due to the characteristics of suspension, is an important factor in the behavior of the car in turns. In most designs the c.g. is above the longitudinal axis of oscillation and, due to soft springs, has a tendency to shift outward on turns due to centrifugal force.

Application of the vehicle brakes further accentuates the shift forward. Thus the braking system becomes unbalanced with respect to the amount of work done and also introduces forces which tend to roll and reduce the resistance to spin and skid. It can, therefore, be concluded that until the c.g. can more nearly approach the plane of wheel rotation, its longitudinal location should be kept close to the wheelbase midpoint or to its rear, depending upon the height of the c.g.

The trends toward a lower c.g., decreased spring rates, the shift in passenger location nearer to the c.g., and the decrease in oscillatory frequency have all contributed to the gradual improvements in ride. If these trends are projected into the postwar cars, a further improvement in passenger comfort may be expected; although further unbalancing of front and rear end weights will increase problems of braking, steering, and behavior over rolling roads or in turns.

Competition Obsoletes Inter-City Bus Design

Digest of paper

by W. A. TAUSSIG
Burlington Transportation Co.

■ Annual Meeting, Jan. 8

(Paper entitled *"Retirement of Inter-City Buses"*)

THRASHING out the complexities of bus retirement requires judgment which, broken down to its simplest components, is nothing more than intelligent guessing. The basic problem, Mr. Taussig declared, resolves itself into the question, "Will the company prosper more or less if we replace the dear old clinker with a bus that is new, snappy, attractive, and perhaps more economical to operate?"

Through this approach it becomes obvious that selection of motor vehicles for transporting passengers is entirely different from that for the transportation of freight. Whereas the freight shipper is not concerned with kind of vehicle used as long as his cargo is delivered promptly and in good shape, the passenger, on the other hand, is extremely interested in the vehicle in which he travels. He will naturally select the bus line offering the most in comfort and luxury, where a competitive route exists, since the fare is the same.

Competition Forces Replacement

With competition assuming such major importance, the old reliable, economical coach that has rendered low cost service for many years must give way to modern equipment to vie successfully with one's competitors for patronage. Such move is advisable even in view of the established fact that modern rear engine or under-floor engine buses cost more to operate than the conventional under-the-hood engine buses.

The common conception that maintenance costs of intercity buses gradually increase with age was proven to be unfounded by Mr. Taussig. Proper maintenance requires that various parts be periodically renewed. After several hundred thousand miles under such program, very few if any of the parts are the originally installed ones and the average age of the parts in the vehicle does not increase. Therefore, a leveling off process of maintenance costs results.

To illustrate this point, Mr. Taussig presented a graphical representation of the actual average maintenance costs of a fleet of buses that have been operating since 1936. The general trend indicated bears out the theory that maintenance costs do level off. The increase for the war period is obviously the result of abnormal conditions and would not have occurred had prewar conditions continued.

Therefore, obsolescence and not maintenance cost is the criterion in retirement of buses. Factors allied to obsolescence are: action of competitor, additional patronage obtainable with new equipment, fuel savings, and maintenance and operating expenses of the new equipment as compared with the old.

Rambling Through Section Reports

cont. from p. 29

KANSAS CITY SECTION members and guests were able to observe engineering, maintenance and overhaul functions involved in the operation of one of the world's largest airlines, Trans World Airlines. "Maintenance and Overhaul Functions" were discussed at the evening air transport session by H. W. Crowther, director of maintenance and overhaul, who stated, summarizing the basic problem, that "an airline flies on its maintenance; the goal of all operators is high utilization."

Forty per cent of non-productive time has been spent in hunting for operating equipment, A. E. Jordan, supervisor of shop equipment and development, reported, pointing out the need for more adequate work stands. Cost of complete overhaul docks is repaid in labor savings and other economic advantages. G. A. Seidel, development engineer in charge of the construction project, discussed the problems involved in the enterprise and the ways in which they were solved.

The history of the application of diesel power to railroads in this country and abroad was reviewed at **NEW ENGLAND SECTION** meeting, May 7, by E. K. Bloss, superintendent of diesel equipment, Boston and Maine Railroad. Fuel savings over steam were shown to be considerable, and maintenance to be handled on a progressive basis . . . unit changes make it possible for diesel locomotives to operate about 95% of the time as compared to the 70% availability of steam locomotives.

Oil City Group, under the sponsorship of Vice-Chairman D. G. Proudfoot, Pennzoil Co., was host to over 50 members of **PITTSBURGH SECTION** for its May 17 meeting. An afternoon of damp golf was followed by dinner and a slide-illustrated report on engine sludge deposits by Carl Georgi, technical director of Quaker State Oil Refining Co.'s research laboratories. Points on which general agreement was reached in discussion between fleet operators and oil technicians were: the most satisfactory way to clean a crankcase is to remove it . . . an ounce of light oil added to each gallon of gasoline prevents valve sticking . . . gasoline is more troublesome than it used to be . . . and crankcases should be kept free of water by keeping them warm, enclosing them in cement or directing exhaust pipes near them, rather than by using water-tolerating oils, since their capacity to absorb water is limited, and the engine can produce unlimited amounts of water.

PHILADELPHIA SECTION'S May 8 meeting featured a talk and demonstration of plastics by W. J. Connelly of the Bakelite Corp., and supplementary musical entertainment in honor of Ladies' Night.

Performance, stability, simplicity of controls, reliability, ease of maintenance and provision for safe emergency landings were named by Allen Price, assistant chief engineer for Platt-LePage Aircraft Co. as the qualities emphasized in the development of the company's by-axial type helicopter. Speaking before the **WILLIAMSPORT GROUP** on May 6, Mr. Price suggested the possibility of a $5000, 2-place helicopter, and predicted extensive use of helicopters in the transport field.

The work of the petroleum technologist in developing suitable fuels and lubricants for new vehicles is made more complex, according to Hugh L. Hemmingway, Pure Oil Co., by the secrecy enveloping automotive improvements. At the May 14 meeting of **CHICAGO SECTION,** Mr. Hemmingway analyzed probable trends in lubricant property requirements, basing his predictions on questionnaires directed to automotive manufacturers. Summarizing answers received, he reported that lubrication of postwar engines probably will be eased by reduction of contamination by means of better filters and the use of bearing materials not susceptible to corrosion; at the same time, the job of lubricating oils will be more difficult because of higher engine temperatures.

Recently returned from a U. S. Strategic Bombing Survey Project tour of Japanese oil refineries, L. F. Schimansky, of California Research Corp., reported his observations at the May 14 meeting of **NORTHERN CALIFORNIA SECTION.** Tracing the history of the industry, he reported that Japanese refining methods before the war were borrowed from the United States and Germany.

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B. J. ANTHIS has been elected vice-president of Air Accessories, Inc., Fort Worth, Tex. He was previously district manager, Aviation Products Division, Goodyear Tire & Rubber Co., Inc., Dallas, Tex.

Previously manager of engineering sales, Pedlar People, Ltd., Oshawa, Ont., Canada, **J. H. THOMSON** has recently joined Thomas Irwin and Son, Ltd., Hamilton, Ont., as sales manager.

J. W. HARLEY, JR., has recently become chief engineer of Wright and Thompson, Petoskey, Mich., designers and engineers. Mr. Harley was formerly chief engineer of the Owosso Division of Bendix Aviation Corp., Owosso, Mich.

OBITUARIES

Christian Girl

Christian Girl, a pioneer automobile spring and parts manufacturer of Cleveland, Detroit, and Chicago, died June 10 at the age of 71 after a long illness. Rising from obscurity as a mail carrier, he organized his first business enterprise, the Perfection Spring Co., with a capitalization of only $1500.

Before he had retired in 1929, his G. G. Spring & Bumper Co. and Standard Parts Co. had a combined capitalization of $35,000,000. These enterprises and the Kalamazoo Spring & Axle Co., which he also controlled, were merged with Houdaille-Hershey Corp., Chicago.

For many years an SAE member, Mr. Girl was a prominent civic leader in Cleveland. During World War I he served as director of military truck production under the late Newton D. Baker, then secretary of War. He won the Army's Distinguished Service Medal for his war work.

John F. Maxwell

John F. Maxwell, 54, sales manager for Roadmaster Products Co., Chicago, died May 22 at the Hotel Olds, Lansing, Mich.

For many years a sales representative on the West Coast for the Chrysler Corp., he originated the Plymouth Factory Service School for dealers' service men and conducted these schools in principal cities throughout the West. He joined the Roadmaster Products Co. in Los Angeles in 1940, and since then had spent some time in Canada furthering the use of Butane.

He was awarded the Civilian Emblem for Meritorious Service after serving as a civilian technician for the USAAF for 21 months in the Africa, Italy, and Sicily campaigns.

A. W. McCalmont

A. W. McCalmont, 64, staff engineer with the Sinclair Refining Co., New York City, died April 5.

Mr. McCalmont began his automotive career with the Jackson Automobile Co., Jackson, Mich., in 1905. After serving as salesman with a number of firms, he returned to the Jackson firm where he was named advertising manager in charge of advertising, general sales work, and service engineering. He served during World War I

as a second lieutenant doing engineering inspection work. After that he was vice-president and chief engineer of the Briscoe Devices Corp. and a consulting engineer with the General Accessories Co.

Eric Sommer

Eric Sommer, 33, a victim of the Chicago hotel disaster, died June 2. He was associated with Linde Air Products Co. of New York City, as assistant to the research manager.

Shortly after his graduation from the University of Michigan in 1935 with a B. S. in chemical engineering, Mr. Sommer joined the Linde organization and had remained with the company until his death. The work conducted under his supervision was comprised of chemical laboratory work and practical testing in small and large engines both on torque stands and in test cars. He was also engaged in research and development work on anti-freezes and other cooling system products.

H. J. Stambaugh, Jr.

H. J. Stambaugh, Jr., died April 24 at the age of 58. Mr. Stambaugh was president of the Burlington Steel Co., Ltd., of Hamilton, Ont. Canada.

Before joining the Burlington firm in 1922, he was successively secretary then vice-president and general manager of Truscon Steel Co. of Canada, Ltd. His first association with the Truscon Steel Co. was in Detroit, Mich., where he served as a salesman connected first with domestic sales, and later as assistant manager of the foreign sales department.

Mr. Stambaugh was elected to membership in SAE in 1936.

Maurice E. Foster

Maurice E. Foster, development engineer, Twin Disc Clutch Co., Rockford, Ill., died April 8 after a short illness. He was 30 years of age.

A junior member of SAE, Mr. Foster was graduated from Iowa State College in 1940 with a degree of B. S. He joined Glenn L. Martin Co. in 1940 as a layout draftsman concentrating on the layout and design of armament equipment for Army and Navy aircraft. In 1941 he became an aircraft engineer with Douglas Aircraft Co., Inc. From August, 1942, until March, 1943, he served as an instructor of electrical mathematics at the Naval Training School at Iowa State College. Shortly thereafter he joined the Twin Disc organization where he was placed in charge of the experimental laboratory.

A. W. Burwell

A. W. Burwell, vice-president of the Alox Corp., Niagara Falls, N. Y., died recently at the age of 78.

Associated with the Alox Corp. since 1926, Mr. Burwell has since that time been engaged in the production of special lubricating-oil, addition compounds, grease compounds, and the development of the Lubarometer for testing oils and lubricating materials. Prior to his affiliation with Alox, he was a consultant specializing in lubricating oils and oil testing. He was for some years a chemist with the Standard Oil Co. (Ohio), Cleveland.

GEOFFREY GILBERT has been elected vice-president of the General Ozone Corp., Chicago. He was formerly vice-president of the Gilbert Process Corp., Plainfield, N. J.

Previously research engineer with the Studebaker Corp., South Bend, Ind., **ROBERT P. FRENCH** has recently joined the Northwest Machine Co., Portland, Ore., as production engineer.

Until recently senior test engineer with Ranger Aircraft Engines, division of Fairchild Engine & Airplane Corp., Farmingdale, L. I., N. Y., **IRENEE du PONT, JR.**, is now machine development engineer with the E. I. du Pont de Nemours & Co., Inc., Plastics Division, Arlington, N. J.

ROBERT SWAN has recently become associated with the Tide Water Associated Oil Co., San Francisco, as motor check mechanic doing demonstration work with chassis dynamometers for the sales department.

W. J. CONNELLY, Creole Petroleum Corp., who had been manager of manufacturing in the New York branch, is now serving with the same organization in Caracas, Venezuela.

CHARLES N. COLSTAD has been appointed vice-president and general manager of Poulsen & Nardon, Inc., Los Angeles, manufacturers of metal goods. He was formerly vice-president of Bay Products Corp., Providence, R. I., and the Lincoln Machine Co., Pawtucket.

Formerly sales engineer with Goodyear Tire & Rubber Co., Akron, Ohio, **HAROLD G. DICK** is now operating manager of the Spines Clothing Co., Wichita, Kans.

CLARENCE L. DANTZER has recently become associated with the Fisher Body Division of General Motors Corp., Central Engineering Department, Detroit, in the body development drafting department. He was previously design engineer with the Paramount Engine Co., same city.

Formerly an engineer with General Electric Co., Lynn, Mass., **ROBERT A. HITCH** has recently joined the De Laval Steam Turbine Co., Trenton, N. J., as gas turbine development engineer.

DANIEL H. LAMB has recently joined the Radiator Research Department of the Perfex Corp., Milwaukee, Wis. He was previously flight test engineer with Wright Aeronautical Corp., Paterson, N. J.

Formerly test supervisor at the General Motors Proving Ground, Milford, Mich., **PAUL D. METZLER** is now a special instructor in the mechanical (automotive) engineering department of the University of Michigan, Ann Arbor.

J. F. SCHENEWERK, JR., has recently become sales engineer with the Tool Supply & Engineering Co., Dallas, Tex. He was previously mechanical and tool engineer with Continental Motors Corp., same city.

D. J. BRACKEN is now general manufacturing manager for Motor Products, Inc., Detroit. He was until recently with Fisher Body Division of General Motors Corp., Pontiac, Mich.

Formerly automotive lubrication engineer with Gulf Research & Development Co., Pittsburgh, Pa., **T. P. SANDS** is now associated with the Monsanto Chemical Co., St. Louis, Mo.

MORRIS P. TAYLOR is now an engineer with the Joshua Hendy Iron Works of Sunnyvale, Calif. He was previously a designer with the Southern Pacific Co., San Francisco.

Formerly mechanical engineer at M.I.T., Cambridge, Mass., **GORDON C. SEAVEY** has recently joined Aircooled Motors, Inc., of Syracuse, N. Y., as research engineer.

JOHN B. BURNELL is now design engineer with the power development section, General Motors Product Study No. 4, General Motors Corp., Detroit. He was formerly layout draftsman, engine and machine design, Chevrolet Motor Division, General Motors Corp.

WILLIAM H. MORITZ, who had been chief engineer with the C. D. Beck Co., Sidney, Ohio, is now commercial car engineer with the Checker Cab Mfg. Corp., Kalamazoo, Mich.

F. W. M. MOORE, who had been serving with Wright Aeronautical Corp., is now associated with Canadian Wright, Ltd., Montreal, Que., Canada.

EVERITT A. CARTER has recently joined Hughes Aircraft Co., Culver City, Calif., as manager of aircraft sales and service. He was until recently an engineer with Wright Aero, Ltd., Los Angeles.

Formerly a student member at Purdue University, West Lafayette, Ind., **LEONARD L. SAX** is now associated with Westinghouse Electric Corp., Pittsburgh, Pa.

HARRY WESTLAND has become sales engineer with the Carpart Corp. of Owosso, Mich. He was previously connected with the Ypsilanti Reed Furniture Co., Iowia, Mich., where he served in a similar capacity.

WILLIAM C. BUNTING, who had been laboratory assistant in the experimental test laboratory of Chevrolet Motor Division, General Motors Corp., has been raised to special test operator of the Chevrolet Engineering Laboratory.

HENRY D. STECHER has been elected president and general manager of the Adalet Mfg. Co., Cleveland. He was formerly president and general manager of the Romec Pump Co., Elyria, Ohio.

JOHN T. DENNY has recently become affiliated with the Federal Telephone & Radio Corp., Clifton, N. J., as liaison engineer.

Formerly assistant eastern engineering representative with Adel Precision Products Corp., Burbank, Calif., **GENE H. WHITE** has recently joined Ellinwood Industries, Ltd., Los Angeles, as special projects engineer.

Formerly a student member at Brooklyn Polytechnic Institute, **BURTON A. JACOBSON** is now a research assistant for Philips Laboratories, Inc., Irvington-on-Hudson, N. Y. He was also a junior engineer with the Air Reduction Sales Co.

ROBERT JARDINE has become coach designer with Reo Motors, Inc., Lansing, Mich. He was until recently development engineer with Dwight Austin & Associates, Kent, Ohio.

R. S. KOMARNITSKY, Standard Steel Spring Co., has been transferred from Madison, Ill., to the Coraopolis, Pa., branch of the company.

L. Ray

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